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A BIBLIOGRAPHY WITH ABSTRACTS OF U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION PUBLICATIONS RELATED TO VEHICLE MOBILITY

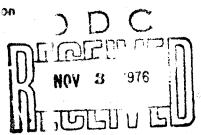
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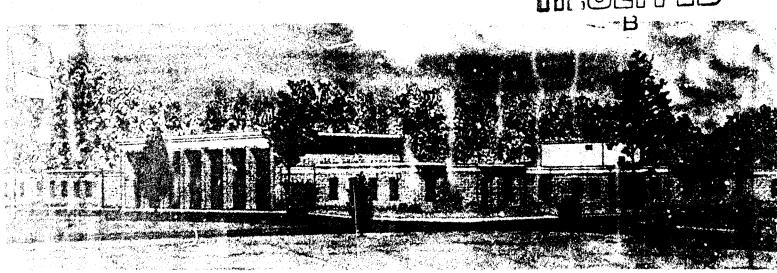
Pavements and Soil Trafficability Information Analysis Cent.

U. S. Army Engineer Waterways Experiment Station P. O. Box 631, Vicksburg, Miss. 39180

August 1976

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Sponsared by U. S. Army Materiel Development and Readiness Command Washington, D. C.

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PREFACE

This publication is a bibliography with abstracts of unclassified reports on vehicle mobility published from 1945 through 1975 by the U. S. Army Engineer Waterways Experiment Station (WES). Most of the reports were prepared by personnel of or under contract to the Mobility and Environmental Systems Laboratory (MESL) of the WES; some of the reports were prepared by personnel of the Soils and Pavements Laboratory. Indexes are included by subject, personal author, corporate author of contract reports, region, and military base. One part contains Document Control Data - R&D or Report Documentation Page data (DD Form 1473) that include abstracts and other pertinent bibliographic information for each report.

The reports include research and development material on ground vehicle mobility and traffice of ity of terrain as related generally to military material and operations. The reports deal with vehicle characteristics, vehicle-driver interactions, vehicle-terrain interactions, characteristics of the terrain over which the vehicle moves, and characteristics of weather that influence terrain. The reports relate to vehicle and soil test equipment, tests of prototype vehicles in the field and their component parts in the laboratory, and tests of soil and snow properties pertinent to trafficability.

The reports have been distributed primarily to the sponsor and certain other agencies having an interest in the work reported. Most of the reports, particularly those published prior to 1970, are out of print. Available copies will be furnished without charge to Federal Government agencies on request until the supplies are exhausted. Reports with AD numbers can be obtained by Department of Defense agencies from the Defense Documentation Center; other agencies and individuals can obtain copies from the National Technical Information Service (see following paragraphs for additional information). Reports prefaced with the footnote "Statement B. See Preface" are limited in distribution or loan to U. S. Government agencies only unless permission for release can be obtained in special cases from the controlling office.

Library copies of the reports are available for loan from the WES Library Branch to Department of Defense agencies. The library loan privilege is ended to other Federal and state agencies, and except for those reports restricted as described above, to scientific and educational institutions and established engineering or industrial firms. In such cases the loan period is usually limited to 30 days. Private individuals not connected with the Department of Decense can usually arrange for library loan either through the main offices of their business concern or by having their local libraries arrange for interlibrary loan. Lending to persons outside the United States is not encouraged because of the extended time periods involved and risk of loss of publications in transit.

All matters concerning the distribution or loar of WES publications should be addressed to the Director, U. S. Army Engineer Waterways Experiment Station, ATTN: WESTV, Post Office Box 631, Vicksburg, Miss., 39180. Matters concerning the technical content of the reports should be addressed to the same address, ATTN: WESFV.

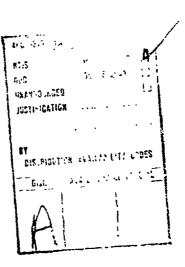
Except for a few reports, the WES no longer sells its publications. Reports listed in this volume having AD numbers can be purchased in microfiche or hard copy from the National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Va. 22161.

This bibliography was compiled by Mr. Marvin P. Meyer, Director, Pavements and Soil Trafficability Information Analysis Center, Stenographic assistance was provided by Mrs. Lottie Merritt, MESL. Miss Virginia Dale and Mrs. Rosemary Peck, Technical Information Center (TIC), assisted in organizing the Decument Control and Report Document Page data. Mr. Woodland G. Shockley, Chief of the MESL, and Mr. A. A. Rula, Chief of the Mobility Systems Division, MESL, were responsible for overall supervision of the work. Mr. Alan G. Skelton, Chief of the TIC, supervised work conducted by TIC personnel. The U. S. Army Material Development and Readiness Command provided funds for the report.

COL G. H. Hilt, CE, was Director of the WES, and Mr. Γ. R. Brown was Technical Director during the report publication.

CONTENTS

	Page
PREFACE	1
ABBREVIATIONS	4
PART I. LISTS OF REPORTS	5
Technical Memoranda	6
Technical Reports	8
Miscellaneous Papers	16
Instruction Reports	26
Pavements and Soil Trafficability Information	
Analysis Center Reports	27
Contract Reports	28
PART II: INDEXES	32
Subject Index	33
Personal Author Index	47
Corporate Author Index (Contract Reports)	55
Region Index	56
Military Base Index	59
PART III: REPORT DOCUMENT PAGE DATA	61
Technical Memoranda	62
Technical Reports	98
Miscellaneous Papers	214
Instruction Reports	390
Pavements and Soil Trafficability Information	
Analysis Center Reports	395
Contract Reports	398



ABBREVIATIONS

CR Contract Report

IR Instruction Report

M Mobility and Environmental Systems Laboratory Report

MP Miscellaneous P. per

NCG Nuclear Cratering Group Report

PSTIAC Pavements and Soil Trafficability Information Analysis Center

Report

S Soils and Pavements Laboratory Report

TM Technical Memorandum

TR Technical Report

U-7/70 Unnumbered Report - Month/Year of Publication

WES Waterways Experiment Station

PART I
LIST OF REPORTS

Technical Memoranda

Number	Date		Title			AD	Numt	er
Unnum- bered	Sep 19	945	Trafficabil	lity	of Soils			
3-240	Nov 19	947	Trafficabil	lity	of Soils, Pilot Tests, Self-Propelled	AD	03	278
	Mar 19	948	Supplement	1	Laboratory Tests to Determine Effects of Moisture Content and Density Variations	AD	108	279
	Aug 19	948	Supplement	2	Trafficability Studies - Fort Churchill, Summer 1947	AD	108	280
	Oct 19	948	Supplement	3	Development of Testing Instruments	AÐ	108	451
	Apr 19	949	Supplement	4	Tests on Self-Propelled Vehicles, Yuma, Arizona, 1947	AD	108	452
	May 19	949	Supplement	5	Analysis of Existing Data	AD	108	453
	Sep 19	949	Supplement	6	Tests on Self-Propelled Vehicles, Vicksburg, Mississippi, 1947	AD	038	092
	Jun 19	950	Supplement	7	Tests on Towed Vehicles, 1947-1948	AD	108	454
	May 19	951	Supplement	8	Slope Studies	AD	108	455
	May 19	951	Supplement	9	Vehicle Classification			
	Jan 19	§54	Supplement	10	Tests on Natural Soils with Self- Propelled Vchicles, 1949 and 1950	AD	034	076
	Aug 19	954	Supplement	11	Superseded by Supplement 16			
	Nov 19	954	Supplement	12	Tests on Natural Sol 5 with Self- Propelled Vehicles, 1951-1953	AD	052	206
	Nov 19	955	Supplement	13	Pilot Study, Tests on Coarse Grained Soils	AD	280	187
	Dec 19	956	Supplement	14	A Summary of Trafficab lity Studies Through 1955	AD	121	975
	Jan 19	959	Supplement	15	Tests on Coarse-Grained Soils with Self-Propelled and Towed Vehicles, 1956 and 1957	AD	218	089
	Aug 1	961	Supplement	16	Soil Classification	AD	265	743
	May 19	963	Supp!ement	1-	fests on Coarse-Grained Soils with Self-Propelled and Towed Vehicles, 1958-1961	AD	409	691
	Mar 19	968	Supplement	18	Development of Revised Mobility Index Formula for Self-Propelled Wheeled Vehicles in Fine-Grained Soils, by J. G. Kennedy and E. S. Rush	AD	832	912
	Apr 19	971	Supplement	19	Effects of Surface Conditions on Drawbar Pull of a Wheeled Vehicle, by F. S. Rush and J. H. Robinson	AD	723	406

Technical Memoranda

Number	Date	Title	AD Number
3-240 (Cont)	Apr 1974	Supplement 20 Development of Vehicle Performance Pre- diction Equations and Classification System for Coarse-Grained Soils, by J. G. Kennedy	AD 778 717
3-331		Forecasting Trafficability of Soils	
	Oct 1951	Report 1 Meteorological and Soil Data, Vicksburg, Mississippi, 1948-1949	
	Jun 1952	Report 2 Meteorological and Soil Data, Vicksburg, Mississippi, 1949-1951	
	Oct 1954	Report 3 The Development of Methods for Predicting Soil Moisture Content	
		Volume 1 Summary Report	AD 053 867
		Volume 2 Prediction Sites at Vicksburg, Miss.	AD 053 868
		Volume 3 Prediction Sites at Other Locations and Related Studies	AD 053 869
		Appendix Special Studies and Records of Soil Moisture and Weather	AD 053 870
	Feb 1957	Report 4 Information for Predicting Moisture in the Surface Foot of Various Soils	
	Jun 1959	Report 5 Development and Testing of Some Average Relations for Predicting Soil Moisture	AD 218 088
	Jun 1963	Report 6 Airphoto Approach	
		Volume I	AD 409 916
		Volume II	AD 410 212
	Jun 1964	Report 7 A Pilot Study of Soils Subjected to Freezing and Thawing	AD 450 626
	Dec 1967	Report 8 Variability of Physical Properties of Loess Soils, Warren County, Mississippi, by C. A. Carlson and A. R. McDaniel	AD 824 443
	Jul 1968	Report 9 Water Table Study at Crossett, Arkansas, by J. R. Bassett and M. P. Meyer	AD 838 517
	Jul 1971	Report 10 Relations of Strength to Other Properties of Fine-Grained Soils and Sands with Fines, by J. C. Col'ins	AD 728 814
3-414		Trafficability of Snow:	
	Aug 1955	Report 1 Vehicles in Snow. A Critical Review of the State of the Art	
	Aug 1955	Report 2 Greenland Studies, 1954	AD 082 188
	May 1960	Rejort 3 Greenland Studies, 1955 and 1957	AD 239 552
	Dec 1960	Report 4 Tests on Subarctic Snow	AD 266 508

Number	Date	Subject	AD Number
NCG 17	Jun 1969	Project TANK TRAP: A Field Evaluation of Nuclear Teriain Barriers	AD 693 817
3-462		Studies of Aeria: Cone Penetrometer.	
	Jul 1957	Report 1 Laboratory Study of Mechanical Principles	AD 138 265
	Apr 1958	Report 2 Field Tests	AD 161 067
	Aug 1963	Report 3 Field Tests in Fine-Grained Soils, 1960	AD 450 613
	Jun 1970	Report 4 Impact Velocity-Impact Force Investigations, 1968, by J. G. Kennedy	AD 871 005
3-516		Deflection of Moving Tires	
	Jul 1959	Report 1 A Pilot Study on a 12x22.5 Tubeless Tire	AD 219 384
	Aug 1961	Report 2 Tests with a 12.00-22.5 Tubeless Tire on Asphaltic Concrete, Sand, and Silt, 1959-1960	AD 265 742
	M ay 1965	Report 3 Center-line Deflection Studies Through July 1963, by M. E. Smith and D. R. Freitag	AD 615 510
3-545		Stresses Under Moving Vehicles	
		Report 1 in this series was published as Miscellaneous Paper No. 4-230	
	May 1960	Report 2 Wheeled Vehicles (M135), Lean and Fat Clav, 1957	AD 238 973
	Jul 1960	Report 3 Tracked Vehicles (M29C, D4, and D7) on Fat Clay, 1956	AD 241 337
	Jul 1964	Report 4 Distribution of Stresses on an Unyielding Surface Beneath Stationary and Towed Pneumatic Tires	AD 450 620
	Jul 1955	Report 5 Distribution of Stresses Beneath a Towed Pneumatic Tire in Air-Dry Sand, by A. J. Green and N. R. Murphy	AD 468 723
3-554	Jul 1960	Validation of Soil-Strength Criteria for Aircraft Operations on Unprepaied Landing Strips	AD 241 546
3-565		Tests with Rigid Wheels	
	May 1961	Report 1 Tests in Fat Clay, 1958	AD 266 \$10
3-588		Project Otter (Overland Train Terrain Evaluation Research):	
	Dec 1961	Report 1 Pretest Report	AD 402 257
	7eb 1965	Report 2 Test Report, by J. H. Shamburger and L. M. Duke	AD 613 166
3-609	Aug 1962	Operation Swamp Fox I, Terrain and Soil Trafficability Observations	AD 290 529

Number	Date	Title	AD Number
5-625	May 1963	Environmental Factors Affecting Ground Mobility in Thailand; Preliminary Survey	AD :11 528
		Apperdix A Results of Survey of Existing Data and Literature	AD 411 530
		Appendix B Soil Classification	AD 411 533
		Appendix C Soil Trafficability	AD 411 534
		Appendix D Vegetation	AD 411 531
		Appendix E Surface Geometry	AD 411 529
		Appendix F Hydrologic Geometry	AD 413 934
		Appendix G Weather and Climate	AD 411 532
		Appendix H Evaluation of Road Observations	AD 411 535
3-639	Jan 1964	Strength-Moisture-Density Relations of Fine-Grained Soils in Vehicle Mobility Research	AD 450 623
3-641	Jan 1964	Trafficability Tests with the Marsh Screw Amphibian on Coarse-Grained and Fine-Grained Soils	AD 450 621
3-652		Measuring Soil Properties in Vehicle Mobility Research	
	Aug 1964	Report 1 Strength-Density Relations of an Air-Dry Sand	AD 450 614
	Oct 1965	Report 2 An Evaluation of the Rectangular Hyperbola for Describing the Load-Deformation Response of Soils, by N. R. Murphy	AD 625 737
	Nov 1970	Report 3 Effects of Velocity, Size and Shape of Probes on Penetration Resistance of Fine-Grained Soils, by G. N. Turnage	AD 878 789
	J. 1971	Report 4 k-lative Density and Cone Penetration Resistance, by KJ. Melzer	AD 729 367
	Jun 1973	Report 5 Resistance of Fine-Grained Soils to High-Speed Penetration, by G. W. Turnage	AD 763 184
	Jul 1974	Report 6 Measuring Soil Properties in Vehicle Mobility Research; Resiscance of Coarse-Grained Soils to High-Speed Penetration, by G. W. Turnage	AD 781 991
	Jun 1975	Report 7 Measuring soil Properties in Vehicle Mobility Research; Behavior of Fine-Grained Soils under High-Speed Tire Loads, by G. W. Turnage	AD A012 146
3-656		Trafficability Tests on Confined Organic Terrain (Muskeg)	
	Sep 1964	Report 1 Summer 1961 Tests, by N. W. Radforth and E. S. Rush	AD 45C 618

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Number	Date	Title		AD Number
3~655 (Cont)	Dec 1965	Report 2 Summer 1962 Tests, by E. S. I Schreiner, and N. W. Radforth	Rush, B. G.	
		Volume I		AD 629 522
		Velume II		AD 735 773
3-665		Performance of Soils Under Tire Loads:		
	Jan 1965	Report i Test Facilities and Technique McRae, C. J. Powell, and R.		AD 456 426
	Aug 1965	Report 2 Analysis of Tests in Yuma Sa. 1962, by C. J. Powell and A.	~ ~	AD 6?1 045
	Feb 1966	Report 5 Tests in Clay Through Novemb Wismer	er 1962, by R. D.	AD 631 029
	Feb 1966	Report 4 Analysis of Tests in Sand fr 1962 Through November 1963, and A. J. Green		AD 632 245
	Jul 1967	Report 5 Development and Evaluation o Numbers for Coarse-Grained S Green		AD 817 122
	Oct 1967	Report 6 Effects of Test Techniques o mance, by N. R. Murphy	n Wheel Perfor-	AD 823 500
	Apr 1972	Report - Extension of Mobility Predic to Rectangular-Cross Section Grained Soil, by T. R. Patin	Tires in Coarse-	AD 741 770
	Sep 1972	Report 8 Application of Test Results for Off-Road Vehicles, by G.		AD 751 750
3-670	Jar 1965	Wheels on Soft Soils; an Analysis of E ν R. Freitag	xisting Data, by	AD 457 8/,
3-681		Mobility Environmental Research Study:		
	Jun 1965	Report 1 A Literature Survey of Envir in Thailand, by J. D. Brough Shamburger, and D. B. Del Ma	ton, J. H.	AD 620 030
⁷ -688	Aug 1965	A Dimensional Analysis of the Performa Tires on Soft Soils, by D. R. Freitag	nce of Pneumatic	AD 621 955
3-693		Terrain Analysis by Electromagnetic Me	ans:	
	Oct 1965	Report 1 Laboratory Investigations in 5.00-Micron Spectral, by B. E. B. Lipscomb, and S. J. Kn	R. Davis,	AD 472 873
	Sep 1966	Report 2 Radar Responses to Laborator Samples, by J. R. Lundien	y Prepared Soil	AD 802 104
	Nov 1967	Report 3 Laboratory Investigations and mev Gamma-Ray Spectral Regard Lundien	and the second s	AD 625 172

Number	Date	Title		AD Number
3-693 (Cont)	May 1967	Emissivity of S	stigations of the Infrared pils Below a Wavelength of N. J. Lavecchia, A. N. H. J. Nikodem	AD 815 453
	Feb 1971	Propagation Con	urement of Electromagnetic stants in the 1.0- to 1.5-GHz ral Region, by J. R. Lundien	AD 881 799
3-702	Dec 1965		Rice Fields and Their Effects G. Kennedy and E. S. Rush	AD 628 734
3-703	Nov 1965	A Study of the Effect: of on the Performance of 2 S by J. L. Smith	AD 625 390	
3-726		Mobility Environmental Remethod for Describing Ter	search Study: A Quantitative rain for Ground Mobility:	
	May 1968	Volume I Summary, by J. Grabau	H. Shamburger and w. E.	AD 835 392
	Jan 1968	Volume [] Surface Compos J. R. Burns	ition, by R. C. Wright and	AD 827 289
	Sep 1967	Volume III Surface Geomet:	ry, by W. K. Dornbusch	AD 820 788
	Mar 1968	Volume IV Vegetation, by Addor	J. D. Broughton and E. S.	AD 830 184
	Nov 1967	Volume V Hydrologic Geor J. H. Shamburg	metry, by E. E. Garrett and	AD 827 290
	May 1966		E. Frost, P. L. Johnson, V. H. Anderson, A. O. Poulin	AD 484 656
	Apr 1968	Volume VII Development of Ground Mobility	Factor-Complex Maps for v, by W. K. Dornbusch	AD 833 829
	June 1966	Folume VIII Terrain factor Areas	-Family Maps of Selected	AD 487 500
5-727	Apr 1966		Use of Radar to Detect Surface Davis, J. R. Lundien, and	AD 483 864
3-729	Jun 1966	Mechanics of Wheels on Soing Yest Results, by E. M	ft Soils, A Method of Analyz- Lefleive	AD 485 854
	Nov 196*	Report 2 Effect of Width by E. M. Leflan	on Rigid Wheel Performance, re	AU 824 232
3-730	Jun 1966	Comparison of Engineering Temperate and Tropical Su	Properties of Selected rface Soils, by M. F. Meyer	AD 486 478
3-744		Trafficability Tests on Un (Muskeg)	nconfined Organic Terrain	
	Vev 1966	Report 1 Summer 1963 Tes Schreiner	ts, by E. S. Rush and B G	AD 805 328

humber	Date	Title	AD Number
3-753	Jan 1967	Trafficability Classification of Thailand Soils, by M. P. Meyer	AD 808 540
3-783		An Analytical Model for Predicting Cross-Country Vehicle Performance:	
	Jul 1067	Appendix A Instrumentation of Test Vehicles, B. O. Benn and Malcolm Keown	AD 817 532
		Appendix B Vehicle Performance in Lateral and Longitudinal Obstacles (Vegetation)	
	Dec 1968	Volume 1 Lateral Obstacles, by C. A. Blackmon and J. K. Stoll	AD 846 257
	Jul 1968	Volume II Longitudinal Obstacles, by C. A. Blackmon and D. D. Randolph	AD 838 872
	Feb 1972	Appendix C Vehicle Performance in Vertical Obstacles (Surface Geometry), by C. A. Blackmon and N. R. Murphy	AD 737 687
	Feb 1970	Appendix D Performance of Amphibious Vehicles in the Water-Land Interface (Hydrologic Geometry), by C. A. Blackmon, B. G. Stinson, and J. K. Stoll	AD 866 165
	Apr 1971	Appendix E Quantification of the Screening Effects of Vegetation on Driver's Vision and Vehicle Speed, by B. G. Stinson	AD 724 070
	Aug 1970	Appendix F Soil-Vehicle Relations on Soft Clay Soils (Surface Composition), by C. A. Blackmon	AD 875 612
3-790	Jul 1967	Pilot Study of Response of CV-2 Aircraft to Irregular Terrain, by A. J. Green and E. S. Rush	AD 818 980
3-791		Moisture-Strength Characteristics of Selected Soils in Thailand	
	Aug 1967	Volume I Analyses and Application of Data, by J. G. Kennedy, J. G. Collins, and M. H. Smith	AD 820 220
	Aug 1967	Volume II Basic Data, by J. G. Kennedy, J. G. Collins, and M. H. Smith	AP 820 221
*3-808	Jan 1968	Evaluation of the Performince of the XM759 Logistical Carrier, by B. G. Schreiner and A. A. Rula	AD 826 114L
M-68-1		Dynamics of Wheeled Vehicles	
	May 1968	Report 1 A Mathematical Model for the Traversal of Rigid Obstacles by a Pneumatic Tire, by A. S. Lessem	AD 834 324
	Aug 1969	Appendix B Digital Implementation of Segmented Tire Model, by N. R. Murphy	AD 35~ 163

^{*} Statement B. See Preface.

Number	Date	Title	AD Number
M-68-1 (Cont)	Mar 1971	Report 2 Implementation of Wiener-Bose Theory and Application to Ride Dynamics, by A. S. Lessem	AD 723 403
	Apr 1971	Report 3 A Statistical Analysis of Terrain-Vehicle- Speed Systems, by N. R. Murphy	AD 723 405
	Mar 1972	Report 4 A Statistical Analysis of Obstacle-Vehicle- Speed Systems, by G. G. Switzer	AD 739 916
M-68-2	May 1968	Contribution to the Mechanics of Rigid Wheels on Sand, by $K.\ W.\ Wiendieck$	AD 833 871
M-69-2	May 1969	Improved Wheel Performance on Sand by Controlled Circumferential Rigidity, by K. W. Wiendieck	AD 688 876
M-70-1	Mar 1970	The Basic Sinkage Equations and Bearing Capacity Theories, by M. J. Hvorslev	AD 869 015
M-70-2	Mar 1970	Performance Evaluation of Wheels for Lunar Vehicles, by D. R. Freitag, A. J. Green, and KJ. Melzer	AD 702 246
M-70-3	Mar 1970	Evaluation of WES Analytical Model in Selected Terrains (XMSS9El GOER Tests at Camp Gagetown, New Brunswick, Canada), by B. G. Stinson	
M-70-4	Mar 1970	Relative Off-Road Mobility Performance of Six Wheeled and Four Tracked Vehicles in Selected Terrain, by J. K. Stoll, D. D. Randolph, and A. A. Rula	
M-70-5	Apr 1970	Performance of Riverine Utility Craft (RUC) in Riverine Environments, by B. G. Schreiner, R. P. Smith, and C. E. Green	AD 869 011
M-70-6	Apr 1970	Quantitative Description of Selected West German Terrain for Ground Mobility, by H. K. Woods and J. H. Shamburger	
M-70-7		Evaluation of the Relative Off-Road Performance of 15 Vehicles in Synthalogous Theaters of Operation (STOP) Terrain Factor Complexes:	
	May 1970	Volume I Application of an Analytical Model for Pre- dicting and Evaluating Vehicle Performance in STOP Terrain Factor Complexes; and Appendix A. Analytical Model for Predicting Cross-Country Vehicle Performance, by D. D. Randolph	
	May 1970	Volume II Appendix B: Vehicle Performance Predictions in Tropical Climate Theater; Appendix C: Vehicle Performance Predictions in Arid Climate Theater; Appendix D: Vehicle Performance Predictions in Temperate Climate Theater, by D. D. Randolph and R. H. Johnson	
M-70-8	Ju 1970	A Preliminary Study of Seafloor Trafficability and Its Prediction, by K. W. Wien-lieck	AD 710 965
*M-70-10	Jul 1970	Relative Off-Road Mobility of MBT70 and M60AlEl Tanks in Selected Terrains in West Germany, by A. A. Rula, C. A. Blackmon, B. G. Stinson, and J. K. Stoll	AD 511 150L

^{*} Statement B. See Preface.

Number	Date	Title	AD Number
M-70-11		Mobil. ty Exercise A (MEXA) Field Tests Program:	
	Mar 1971	Report 2 Volume 1, Performance of MEXA and Three Military venicles in Soft Soil, by B. G. Schreiner	AD 883 199
	Jul 1970	Report 3 Performance o ÆEXA and Three Military Vehicles in Lateral Obstacles, by J. L. Decell	AD 875 940
	Jan 1974	Report 4 Performance of Selected MEXA and Military Vehicles in Vertical Obstacles, by N. R. Murphy, Jr., and A. A. Rula	
%-70-12	Jul 1970	European Waterways Study; a Procedure for Describing Tactical Gaps, by P R. Friesz, A. P. Desmarais, K. S. Fife, W. G. Willis, and W. E. Grabau	
*		Volume I	AD 875 511L
•		Volume 2	AD 875 512L
*		Volume 3	AD 875 54úL
M-70-14		Penetration Resistance of Soils:	
	Nov 1970	Report 1 Tests with Circular Footings in Air-Dry Sands, by A. J. Green	AD 715 979
	Nov 1970	Report 2 Gamma-Ray Techniques for Nondestructive Measurements of Soil Density and Density Pro- file, by A. N. Williamson	AD 715 980
	Jul 1971	Report 7 Tests with Circular Footings in Cohesive Soils, by A. J. Green	AD 726 968
M-70-15	Oct 1970	Performance of Boeing-GM Wheels in a Lunar Soil Simulant (Basalt), by A. J. Green and KJ. Melzer 'Superseded by M-71-10, Report 1)	
*M-71-1	May 1971	Performance Evaluation of a First-Generation Elastic Loop Mobility System, by KJ Melzer and A. J. Green	AD B007 715L
M-71-4	Jul 1971	An Analysis of Ground Mobility Models (ANAMOB), by A. A. Rula and C. J. Nuttall	AD 886 513
M-71-5		Performance of Soils Under Track Loads:	
	Jul 1971	Report 1 Model Track and Test Program, by G. W. Turnage	AD 728 496
	Nov 1971	Report 2 Prediction of Track Pull Performance in a Desert Sand, by G. W. Turnage	AD 733 926
M-71-6	Sep 1971	Prediction of the Slope-Climbing Capability of Elastic-Rim Wheels, by K. W. Wiendieck	AD 731 205
M-71-7	Oct 1971	Effect of Yaw Angle on Steering Forces for the Lunar Roving Vehicle Wheel, by A. J. Green	AD A006 518

^{*} Statement B. See Preface.

Number	Date	Title	AD Number
M-71-8	Nov 1971	Performance of Dual-Wheel Configurations in Coarse-Grained Soil, by KJ. Melzer	AD 732 864
M-71-10		Performance of the Boeing LRV Wheels in a Lunar Soil Simulant:	
	Dec 1971	Report 1 Effects of Wheel Design and Soil, by A. J. Green and KJ. Melzer	AD 756 213
	Dec 1971	Report 2 Effects of Speed, Wheel Load, and Soil, by KJ. Melzer	AD A006 498
M-72-1	Jun 1972	Studies of the Dynamics of Tracked Vehicles, by A. S. Lessem and N. R. Murphy	AD 743 464
M-73-1	Sep 1972	Vehicle Mobility Assessment for Project Wheels Study Group (With Addenda), by A. A. Rula, C. J. Nuttall, Jr., and H. J. Dugoff	AD A008 286
*M -73-5	Aug 1973	A Numerical Model of the Ride Dynamics of a Vehicle Using a Segmented Tire Concept, by W. F. Ingram	AD 913 281L
S-73-13	Jec 1973	Vehicle/Rund Compacibility Analysis and Modification Systems (VRCARS), by V. C. Baroer and N. R. Murphy	AD /72 962
M-74-1	Jan 1974	Helicopter Movement on Unimproved Terrain, by E. S. Rush and C. E. Green	AD 780 698
*M-74-3	Apr 1974	A Variable-Stress Vehicle Reliability Model, by A. S. Lessem	AD 919 333L
M-74-7	Jun 1974	Performance Evaluation of a Second-Generation Elastic Loop Mobility System, by KJ. Melzer and G. D. Swanson	
S-74-7	Sep 1974	Stresses and Shearing Resistance in Soil Beneath a Rigid Wheel, by M. M. Al-Hussaini and P. A. Gilbert	AD A000 609
M-75-1	Jun 1975	Small-Scale Mobility Tests in Fine-Grained Layered Soils, by G. D. Swanson, and T. R. Patin	AD A013 491

^{*} Statement B. See Preface.

Number	Date	Title	AD Number
4-19	Nov 1952	Report on Trafficability Conditions and Airfield Site Selection in an Area in Norfolk County, East Anglia England	
4-73	Sep 1954	A Study of Moisture-Content Determinations on Selected Soils	AD 041 085
4-101	Nov 1954	Trafficability Survey of Selected Areas, Camp Stewart Georgia	
4-117	Mar 1955	Field Tests of Nuclear Instruments for the Heasurement of Soil Moisture and Density	AD 073 388
4-135	Jul 1955	The Development of Methods for Predicting Soil Moisture Content, Report on the Fairbanks, Alaska, Extension	AD 747 826
4-147	Jan 1956	Vehicle Mobility on Soft Soils	AD 841 344
4-230		Stresses Under Moving Vahicles:	
	Ju: 1957	Report 1 A Pilot Study of WES Earth Pressure Cell Actio. in Comparatively Soft Soil (See TR 3-545 for subsequent reports in this series)	AD 841 345
4-238	Nov 1957	Statistica! Occurrence of Soil Strength	
4-241	Oct 1957	Vehicle Mob:lity	AD 841 746
4-282	Aug 1958	Comparison of Performance Characteristics in Snow of the Polecat and Weasel	
4-284	Aug 1958	A Limited Study of Factors That Affect Soil Strength	
4-298	Jan 1959	Meteorological and Trafficability Data, U. SCanadian Arctic Weather Stations	AD 756 305
4-300	Jan 1959	Aer al Penetrometer Demonstration at Fort Rucker, Alabama	AD 625 601
4-322	Feb 1959	A Limited Study of Snap-Tracs	D 756 291
4-327	Mar 1959	Effect of Mold Size and Other Factors on Laboratory Cone Index Measurements	AD 841 347
4-338	Apr 1959	Prediction of Soil Moisture from Soil and Weather Records	AD A006 496
4-351	Jul 1959	Filot Study to Evaluate the Squeeze Tes? for Use in Vehicle-Mobility Research	AD 841 348
355		Trafficability Predictions in Tropical Soils:	
	Sep 1959	Report 1 Four Soils in the Panama Canal Zone	AD A006 520
	Feb 1960	Report 2 Puerto Rico Study	

Number	Date	Title	AD 'umber
4-355 (Cont)	Aug 1966	Peport 3 Panama Study No. 2 (October 1961-September 1953), by A. R. McDaniel	AD PO1 321
	Nov 1967	Report 4 Columbia Study (July 1962-July 1963), by A. R. McDaniel	AD 824 754L
*	Dec 1987	Report 5 Costa Rica Study No. 1 (January 1963-January 1965), br A. R. McDaniel	AD 824 882L
	Nov 1968	Report 6 Puerto Rico Study No. 2 (March 1962-November 1963), by J. G. Fennedy and T. E. Hicks	AD 845 616
	Nov 1970	Report 7 Hawaii Study, by C. A. Carlson, W. P. Bohnert, and M. P. Meyer	AD 877 577
•	Aug 1971	Peport 8 Costa Rica Study No. 2 (January 1964- September 1965), by A. R. McDaniel and M. H. Smith	AD 888 001L
4-362	Oct 1959	Preliminary Study of Stresses Under Off-Road Vehicles	AD 841 349
4-365	Nov 1959	Traffic Evaluation Tests of Rogers Dry Lake, California	
4-371	Jan 1800	Laboratory Tests of Liquid Nitrogen Soil-Moisture Samplers	AD 756 311
4-394	May 1960	Strength Requirements in Unsurfaced Soils for Aircraft Operations	
4 404	Jul 1960	The Army Mobility Research Center Testing Facility	
4-412	Nov 1960	A Limited Study of the Performance of the 2-Ton Meili Flex-Trac	AD 756 321
3-428	Jan 1961	Physical Components of the Shear Strength of Saturated Clays	
4-438	Jul 1961	Trafficability Tests with Jumbo Truck on Organic and Coarse-Grained Mineral Soils	AD 756 331
4-439	Aug 196:	Trafficability Tests with the Airoll on Organic and Mineral Soils	AD A006 497
4-441	Aug 1961	Measurement and Estimation of the Trafficability of Fine-Grained Soils	
4-4/2	Aug 1961	Soil Trafficability Classification Scheme	
4-443	Aug 1961	The Behavior of Sand Under Pneumatic Tires	
4-444	Aug 1961	Classification of Terrain for Mobility Purposes	AD 666 222
4-446	Aug 1961	Comparison of Trafficability of Muskeg with Trafficability of Other Soft Soil Terrains	AD 754 332
4-447	Aug 1961	Properties of Surface Soils in the West Season	AD 754 335
4-457	Nov 1961	Some Factors Affecting Moisture Content-Density- Cone Index Relations	AD 753 641

^{*} Statement B. See Preface

Number	Date	Title	AD Number
4-461	Dec 1961	A Technique for Mapping Trafficability	AD 754 334
4-462	Dec 1961	Measuring Soi: Trafficability Characteristics	AD 754 333
4-463	Dec 1961	Stresses in Yielding Soils Under Moving Wheels and Tracks	
4-469	Feb 1962	Distribution of Stresses on an Unyielding Surface Jeneath a Pneumatic Tire	
1-47?	Ap- 1962	Trafficability Tests with the 5-Ton GOER (XM520) on Fine- and Coarse-Grained Soils	AD 646 591
3-482	Apr 1962	Predicting Soil-Moisture Distribution in Areas of Seasonal Frost, Reasibility Study	AD 756 302
4-497	May 1962	Deflection of a Moving Tire on Firm to Soft Surfaces	
4-505	Aug 1962	Operation Wheeltrack, Camp A. P. Hill, Virginia, 25-30 April 1962	
4-513	Jul 1962	Arroll Performance in Snow	AD 744 463
Unnum- bered	Aug 1962	Report of Mobility Consultants Conterence, Waterways Experiment Station, Vicksburg, Mississippi, 13-15 June 1962	
4-528	Sep 1962	Documentation of Conditions Attendant to Army Tactical Mobility Requirements (Howze) Board Testing	AD 744 213
4-535	Oct 1962	A Technique for Estimating the Slope-Climbing Ability of Wheeled Vehicles in Sand	AD 744 214
4-547	Jan 1963	Identifying Soil Parameters with an Infrared Spectro- photometer	AD 744 220
4-556	Jan 1963	Visit to Swamp Fox II Operation	
3-592	Jul 1963	Terrain Evaluation for Mobility Purposes	AD 744 216
4-594	Aug 1963	Visit to University of Illinois to Discuss Tropical Soils Studies	AD 7-4 217
4-602	Oct, 1963	Study of the Characteristics of Rice Fields in the United States	AD 744 215
4-621	Jul 1963	Speed Tests Conducted in Canada During Muskeg Trafficability Test Program, August 1962	AD 744 219
4-623	Feb 1964	Comments on Mobility Research	AD 744 221
4-626	Feb 1964 Revised Sep 1964	Theory for a Towed Wheel in Soil	AD 744 132
4-629	Feb 1964	Normal Stresses at the Tire-Soil Interface in Yielding Soils	AD 744 724
4-630	Feb 1964	Terrain Reconna; sance with Electromagnetic Sensors	
4-638	Apr 1964	The Terrain-Vehicle Programs of the U.S. Army Engineer Waterways Experiment Station	AD 744 218
4-64?	Apr 1964	Variation in the Trafficability of Sands	

Number	Date	Title	AD Number
4-651	Мју 1964	Tracks Versus Wheels in Soft Soil and Snow	AD 744 222
4 -652	May 1964	A Comparison of Quantitative Versus Nonquantitative Terrain Descriptive Systems for Mobility Analysis	7 745 148
4-670	Aug 1964	Report of Second Meeting of ARA Advisory Committee on Mobility Environmental Research Study (24-26 February 1964, Vicksburg, Mississippi)	AD 478 994
4-687	Dec 1964	Retention of Detail in Map General zation, by E. E. Addor and W. E. Grabau	AD 745 149
4-702	Feb 1965	Vicksburg Mobility Exercise A, Vehicle Analysis for Remote-Area Operation, by 3. J. Knight	AD 613 366
4-713	Mar 1965	Trafficability of Snow in Arctic and Subarctic Regions, by B. G. Schreiner	AD 745 150
4-726		Mobility Environmental Research Study:	
	Jun 1965	Report 1 Selection and Description of Test Areas, U. S. Military Reservations, by H. K. Woods and J. H. Shamburger	AD 745 151
4-743	Oct 1965	Tests to Evaluate the Mobility of Jiger and Fisher Vehicles, by M. P. Meyer	AD 901 950
3-749	Nov 1955	Statistical Evaluation of Cone-Penetration-Test Data, by J. K. Poplin	AD 736 121
4-750	lov 1965	Center-Line De?lection of Phoumatic Tires Moving in Dry Sand, by D. R. Freitag and M. E. Smith	AD 745 152
4-751	Nov 1965	Trafficability Tests with the Marsh Screw Amphibian, by S. J. Knight, E. S. Rush, and B. G. Stinson	AD 745 153
4-757	Nov 1965	A Study of the Effects of Wet Surface Soil Conditions on the Performance of a Single Wheel, by J. L. Smith	AD 745 154
4-758	Dec 1965	Mechanics of Whiels on Soft Soils; A Method for Presenting Total Results, by E. M. Leflaive	AD 746 399
4-766	Jan 1966	Tests with the CH-47A Chincok Helicopter in Soft Clay Soil, by E. S. Rush	AD 627 3/7
4-767	Jan 1966	Effects of Air Surcharge on the Bearing Capacity of Soft Cohesive Soils, by L. J. Lanz	AD 630 804
4-769	Dec 1965	Traffic Tests to Determine the Benefits of Vegetation in Increasing Traffic Coverages, by L. M. Womack	AD 745 622
4-791	Feb 1966	Report of Conference of the Board of Consultants on Remote Terrain Analysis by Electromagnetic Means; Waterways Experiment Station, 18-19 November 1965	AD 747 095
4-822	May 1966	Effects of Soil Layering on the Use of VHF Radio Waves for Remote Terrain Analysis, by H. J. Nikodem	AD 747 095

Number	Date	Title	AD N	lumber
4-823	May 1966	Laboratory Investigations of the Gamma-Ray Spectral Region for Remote Determination of Soil Trafficability Conditions, by A. N. Williamson	AD 7	47 097
4-828	Jul 1966	Development of a Formula for Towing Resistance for a Wheel in Soft Soi! by J. L. McRae	AD 7	46 400
4-829	Aug 1966	Comparison of Ground Mobility Characteristics of Land- Marine Interfaces or Florida and Thailand, by E. E. Garrett	AD 8	300 075
4-835	Aug 1966	A Dimensional Analysis of the Performance of Pneumatic Tires on Clay, by D. R. Freitag		
4-836	Aug 1965	A Dimen ional Analysis of the Performance of Pneumatic Tires on Sand, by D. R. Freitag	AD 7	716 541
4-838	Aug 1966	Variation in Trafficability of Four Loess Soils, by J. R. Bassett, A. R. McDaniel, and S. J. Kright	AD 8	300 144
4-854	Nov 1966	Concepts for Vehicles for Off-Road Use in Remote Areas, by A. A. Rula, D. R. Freitag, and S. J. Knight	AĐ 7	46 401
3-861	Dec 1966	Terrain Evaluation of a Fortion of the Fort Greely Automotive Test Course; Final Report, by J. H. Shamburger, C. R. Kolb, and H. K. Woods	AD 8	306 538
4-870	Feb 1967	Theory for Predicting Performance of a Wheel in Soft Soil, by J. L. McRae		
4-879	Mar 1967	Trafficability Tests in Fine-Grained Soils with Two Vehicles with 9- to 10-Ton Wheel Loads, by E. 3. Rush	AD 8	217
unnum · bered	Apr 1967	Report of Conference on Soil Trafficability Prediction, U. S. Army Engineer Waterways Experiment Station, 29-30 November 1966	AD A	.019 176
4 -893	May 1967	Bumps and Grinds: Study in Body Motions, by W. G. Shockley	AD 7	47 098
4-899	May 1967	Aerial Cone Penetromiter for Measuring the Trafficability of Soils, by S. J. Knight	AD 7	46 402
4-917	Aug 1967	Trafficability Tests with a Two-Wheel-Drive Industrial Tractor, by E. S. Rush and B. G. Stinson	AD 8	19 857
4-921	Aug 1967	A Suggested Procedure for the Selection and Description of Reference Test Areas, by W. E. Grabau	A! 6	58 659
4-923	Aug 1967	Flotation Requirements for Aircraft, by R. C. Ahlvin and D. N. Brown	AD 7	39 551
* 4-940	Oct 1967	Soil Buildup Between Wheels and Sponson of XM759 Logistical Carrier, by E. C. Rush	AD 9	02 843L
4-912	Oct 1967	Effects of 'read Pattern on the Surface Traction of Terra-Tires, by J. L. Smith	AD 7	47 099
4-944	Nov 1967	A Qualitative Approach to the Pneumatic Tire-Soft Soil System, by L. M. Kraft	AD 8	23 995

^{*} Statement B. See Proface.

Number	Date	Title	AD Number
*4-948	Sep 1967	Ground-Flotation Investigation of Model Wide Tire, by J. E. Watkins and W. J. Hill	AD 822 345L
4-949	Dec 1967	Expedient Surface-Soil Sampling, by S. J. Knight and C. A. Blackmon	AD 746 350
4-950	Dec 1967	A Limited Study of Effects of Soil Strength on Walking Speed, by E. S. Rush and A. A. Rula	AD 746 403
4-959	Jan 1968	Application of Trafficability Analysis to Forestry, by D. R. Freitag and B. 7. Richardson	AD 746 404
4-960	Jan 1968	Penetration Tests for Soil Measurements, by D. R. Freitag	
4-961	Jan 1968	Summary of Comparison of Engineering Properties of Selected Temperate and Tropical Surface Soils, by M. P. Meyer	AD 746 757
4-979	Mar 1968	Report of Second Meeting Vicksburg Mobility Exercise A, Design of Field Test Program (8-10 February 1967, Vicksburg, Mississippi)	
4-986	Apr 1968	Gamma-Ray Measurements to Evaluate Soil Properties, by A. N. Williamson	
M-68-1	Aug 1968	Effects of Test Techniques on Wheel Performance, by N. R. Murphy and A. J. Green	AD 746 758
M-68-2	Aug 1968	Description and Comparison of Tire Performance in Sand in Terms of Energy Parameters, by E. M. Leflaive	AD 746 759
M-68-4	Sep 1958	Trafficability Tests with Major/Minor Wheel Vehicle Equipped with 16x14.5-6 Tires, by J. H. Robinson and E. S. Rush	AD 841 855
M-68-5	Dec 1968	Simulating Dynamic Pice Characteristics of Pneumatic Tires, by A. S. Lessem	
M-68-6	Dec 1968	Stress-Displacement Relations and Terrain-Vehicle Mechanics: A Critical Discussion, by Y. W. Wiendieck	
M-68-7	Dec 1968	A Mathematical Model for Traversal of Rigid Obstacles by a Pneumatic Tire, by A. S. Lessem and A Green	
M-68-8	Dec 1968	A Theoretical Evaluation of the Shear-to-Normal Stress Ratio at the Soil-Wheel Interface, by K. W. Wiendieck	
M-69-1	Jan 1969	Trafficability Tests with a Rubber-Tired Log Skidder, by B. Y. Richardson, J. H. Robinson, and R. P. Smith	AD 848 416
M-69-2	Jun 1969	Vehicle Dynamics Research at Waterways Experiment Station, by A. J. Green and G. G. Switzer	AD 746 760

^{*} Statement B. See Preface.

Number	Date	Title	AD Number
M-69-4	Sep 1969	Limited Trai icab.lity Tests with Major/Minor Wheel Vehicle Equipped with 20x14-10 Tires, by J. H. Robinson and R. P. Smith	AD 859 719
M-69-5		Utility Carrier Development Program:	
	Oct 1969	Report 1 Limited Study of Effects of Jungle Trail Characteristics on Performance of Selected Self-Propelled Vehicles, by E. S. Rush	AD 753 427
•	Oc 1969	Report 2 Limited Study of Effects of Vegetation Characteristics on Pertormance of Selected Self-Propelled Vehicles, by J. L. Decell, T. D. Hutto, and A. A. Rula	AD 902 842L
M-69-6	Dec 1969	The Role of Ground Crawling Vehicles in the Ccean, by K. W. Wiendieck and D. R. Freitag	
M-69-7	Dec 1969	Effects of Cone Velocity and Size on Soil Penetration Resistance, by G. W. Turnage and D. R. Freitag	
M-69-8	Dec 1969	A General Theory of Stresses and Displacements in Elastic and Viscoel stic Layered Systems, by Yu-Tang Chou	
S-69-15	Apr 1969	Evaluation of Nuclear Methods of Determining Surface In Situ Soil Water Content and Density, by T. B. Rosser and S. L. Webster	AD 688 079
*M-70-2	Apr 1970	Worldwide Strength Coaditions of Surface Materials, by W. P. Bohnert and M. P. Meyer	AD 869 490L
M-79-4	May 1970	Performance Evaluation of Wheels for Lunar Vehicles (Summary Report), by D. R. Freitag, A. J. Green, and KJ. Melzer	AD 705 570
M 70-6	May 1970	Effect of Pressure Distribution Under Pneumatic Tires on Stresses and Displacements in the Supporting Elastic Media, by Y. T. Chou	
4- 70-7	Sep 1970	A Plan for Quantitative Evaluation of the Cross-Country Performance of Prototype Vehicles, by W. E. Grabau, J. K. Stoll, and B. G. Stinson	AD 877 016
M-70-8	Dec 1970	Tests with an Experimental Wheel on Clay, by K. W. Wiendieck	
* M-7∪-9	Dec 1970	Limited Performance Tests of the XM759, 1-1/2-ton Logistical Carrier, Amphibious, by B. G. Shreiner and E. S. Rush	AD 879 172L

^{*} Statement B. See Preface.

Number	Date	Title	AD dumber
M-70-10	Dec 1970	Effects of Soil Surface Conditions on Drawbar Pull of a Whoeled Vehicle, by E. S. Rush	
S-70-14	'lay 1970	Evaluation of Soil Strength of Unsurfaced Forward-Area Airfields by Use of Ground Vehicles, by G. M. Hammitt	AD 709 589
S-70-24	Sep 1970	Soil Strength Criteria for Operation of Fighter Aircraft On Unsurfaced Airfields; Bare Base Support; Project 378?- 65, by D. M. Ladd	
S-70-25	Nov 1970	The Effects of Geological Features on Soil Strength, by E. L. Krinitzsky	AD 756 159
M-71-1	Feb 1971	Standard Penetration Test and Relative Density, by KJ. Melzer	
M-71-2	Feb 1971	Evaluating Penetration Tests in Clay from Measured Soil Particle Movements, by Y. T. Chou	
M-71-3	Feb 1971	The Performance of Two Boeing-GM Wheels (GM VII and Of VIII) for the Manned Lunar Rover Vehicle, by A. J. Green and KJ. Melzer	
M-71-4	Mar 19'1	Event Dial Pack; Project LN309: Effectiveness of Craters as Barriers to Mobility, by C. A. Blackmon and A. A. Rula	AD 720 986
M-71-5	Jun 1971	Utilization of Synthetic Soils in Engineering Research, by A. J. Green	AD A006 519
M-71-7	Nov 1971	Automation of Cross-Country Locomotion Model, by J. A. Parks and J. κ . Stoll	
M-72-2	Apr 1972	Effect of Design Changes on Vehicle Performance; A Limited Study of the M35A2 (Modified) and the M113A1	AD A017 725
M-72-3	Apr 1972	Operations and Maintenance Manual for a Scale-Model Lunar Roving Vehicle, by A. S. Lessem	AD 757 392
M-72-5	May 1972	Evaluation of Surface Shear Strength Measurements for Use in Laboratory Mobility Studies, by T. R. Patin	AD 743 167
S-72-9	Mar 1972	Notes on Proving Rings and Frames for Soil Testing Equipment, by M. J. Hvorslev	AD 756 199
*S-72-34	Nov 1972	Relative Surfacing Requirements for Container-Handling Vehicles, by D. N. Brown, A. A. Clark, R. J. Lacavich, and E. S. Rush	AD 905 195L
M-73-1	Jan 1973	Automation of a fodel for Predicting Soil Moisture and Soil Strength (SiASP Model), by M. H. Smith and M. P. Meyer	AD 755 095
M-13-2	Apr 1973	Power Requirements for Wheels Operating in Fine-Grained Soils, by KJ. Melzer	AD 759 501
M-73-4	May 1973	Suggested Method for Application of the WES VCI/RCI Criteria to Helicopters and Related Ground Support Equipment, by E. S. Rush	AD A017 731

^{*} Statement B. See Preface.

Number	Date	Title	An Number
M-73-5	Jun 1973	Event Mixed Company III; Project LN305: Effectiveness of Craters as Barriers to Mobility, by C. E. Green	AD 910 627
M-73-6	May 1973	Project DIAMOND ORE; Phase IIA: Effectiveness of Craters as Barriers to Mobility, by C. A. Blackmon and C. E. Green	
M-73-7	May 1973	Analysis of the Ability of a Laser Profilometer System to Evaluate Unprepared Landing Sites, by L. E. Link, Jr.	AD 763 180
*M-73-14	Sep 1973	Vehicle Mobility Assessment of Munitions Transfer Truck on Selected Areal Terrains, by B. G. Shreiner and W. F Willoughby	A9 6007 716L
M-73-15	Dec 1973	The Effect of Military Transportation Activities on the Environment, by A. J. Green, D. D. Randolph, and A. A. Rula	
M-73-16	Dec 1973	Prediction of Aircraft Ground Performance by Evaluation of Ground Vehicle Rut Depths, by G. W. Turnage and D. N. Brown	AD 775 744
Unnum- bered	Mar 1974	Terrain Analysis for the Armored Reconnaissance Scout Vehicle Test Program, by D. D. Randelph and C. A. Blackmon	AD 776 387
M-74-1	Apr 1974	A Limited Study of the Performance of an Interim 3/4-Ton Wheel/Track Convertible Test Rig, Houghton, Michigan, and Vicksburg, Mississippi, by W. E. Willoughby	
M-74-3	May 1974	A Preliminary Study of Scale-Model Bulldozer Blades	
M-74-5	Aug 1974	Beach Trafficability Testing with Off-Road Materials Handling Equipment, Anzio Beach, Little Creek, Virginia, by E. S. Rush	AD A017 723
*M-74-6	Aug 1974	Mobility Validation Test Results for the Armored Reconnaissance Scout and Comparison Vehicles, by W. E. Willoughby and B. G. Schreiner	AD B003 764L
M-74 7	Sep 1974	Characterization of Selected Road Sections in Western United States, by . A. Rula and J. H. Robinson	AD A018 289
M-74-8	Oct 1974	Mapping of Selected ARSV Test Courses at Fort Knox, Kentucky, and Comparison with Other Selected Terrains, b D. D. Randolph	AD A001 520
M-75-3	Apr 1975	Project ESSEX I, Phase 1, Mobility Experiments, by C $$ E $$ Green	AD A011 493
*M~75-4	May 1975	Terrain Description, Vehicle Mobility and Cover Concealment Characteristics for the Bushmaster Middle East and Europe Scenarios; A Qualitative Assessment, by H. W. West and B. G. Schreiner	AD B005 325L
M-75-5	Jun 1975	Comparison of the Ride Qualities of Standard M60Al and Hybrid (Tube-Over-Bar) M60AlE3 Tanks, by N. R. Murphy Jr. and J. H. Robinson	AD A013 986

^{*} Statement B. See Preface.

Mi rellaneous Papers

Number	Date	Title	AD Number
M-75-7	Jun 1975	WES Papers Presented at Fifth International Conference, International Society for Terrain-Vehicle Systems, June 2-6 1975, Detroit-Houghton, Michigan	AD A012 653
M-75-8	Aug 1975	Estimating the Performance Capabilit, of 50,000-lb Capacity Container Handler on Beach and Desert Sands, by E. S. Rush and G. N. Durham	AD A014 273

Instruction Reports

Number	Date	Title	AD Number
Unnum- bered	Oct 1961	Tropical Soil Studies; Plan of Tests	
Unnum- bered	Jan 1962	Tropical Soil Studies in Panama and Puerto Rico; Plan of Tests	
7	Oct 1965	Description and Application of Airfield Cone Penetrometer, by W. B. Fenwick	AD 800 746
S-70-1	Apr 1970	Rapid Assessment of Soil Strength at Aircraft Landing Sites, by G. M. Hammitt	AD 705 572
S-74-1	Apr 1974	Determination of In-Place Moisture and Density by Nuclear Methods, by S. L. Webster	AD 779 422
	Jun 1974	Errata Sheet No. 1	

Pavements and Soil Trafficability Information Analysis Correr Reports

Number	Date	Title	AD Number
1	Apr 1975	Microthesaurus of Vehicle Mobility, Environment, and Pavement Terms	AD A011 269
2	Nov 1975	Bibliography of Papers Presented at Meetings or in Technical Journals on Studies of the Mobility and Environmental Systems Laboratory, by M. P. Meyer	AD A018 290

Number	Date	Contractor and Title of Report	AD Number
		Purdue University, Engineering Experiment Station	
4-6		Application of Airphoto Pattern Analysis to Soil Trafficability Studies:	
	Jun 1951	Book One By O. W. Mintzer, E. J. Yoder, and J. R. Shepard	
	June 1951	Book Two Glacial Patterns	
		Book Three Alluvial Patterns	
	Dec 1952	Book Three (Second Edition) Water Deposited Materials	
	Jun 1951	Book Four Miscellaneous Patterns	
	Feb 1954	Book Five Wind Deposited Soils	
	Jun 1954	Book Six Residual Materials (in 2 parts)	
	Sep 1956	Supplement No. 1 Prepared by R. D. Miles and R. D. Leighty	
	Dec 1957	Supplement No. 2 Glacial Deposited Materials, prepared by R. D. Miles and D. G. Shurig	
		U. S. Forest Service	
4-8		The Development of Methods for Predicting Soil Moisture Content	
	Nov 1951	Progress Report I	
		Volume I, by E. J. Dortignac and H_{\odot} W. Lull	
		Volume II, by E. J. Dortignac and H. W. Lull	
	Jul 1952	Progress Report II	
		Purdue University, Engineering Experiment Station	
4-12A	Oct 1954	Effect of Soil Moisture and Other Natural Variables on Aerial Photo Gray Tones	
		Cornell University	
3-15	May 1955	An Environmental Analysis of the Fort Churchill, Manitoba, Region, by T. A. Cheney and D. K. B. Beckel	
		Text I	
		Text II	
		Folio	
		Wilson, Nuttall, Raimond Engineers, Inc.	
4-16	Oct 1955	Vehicle Mobility Research: A Preliminary Review of Major Accomplishments and Current Activities in the Field, by C. J. Nuttall	
4-17	Mar 1956	Vehicle Mobility Research, 1956: A Review and a Suggested Program, by C. J. Nuttall	

Number	Date	Contractor and Title of Report	AD Number
		Purdue University	
4-20	Sep 1956	Techniques for Predicting Soil Trafficability Information from Aerial Photographs, by R. D. Miles	
		U. S. Geological Survey, Military Geology Branch	
3-22	1957	Terrain Study of the Army Test Area, Fort Greely, Alaska	
		Volume 1 Text, by G. W. Holmes and W. S. Benninghoff	
		Volume 2 Maps	
		FMC Corporation, Ordnance Engineering Division	
3-33	Sep 1964	A Research Study Concerning the Application of a Fourier Series Description to Terrain Geometries Associated with Ground Mobility and Ride Dynamics Phase I: Terrain and Vehicle Models	
		University of Illinois	
3-38	Oct 1959	Report on Survey of Literature in Connection with the Dynamic Bearing Capacity of Soils, by Narbey Khachaturian	
		Texas Instruments Incorporated	
4-96		Phase I System Analysis for a Waverways Experiment Station Terrain Analysis Radar (Project WESTAR); Final Report	
	Jan 1963	Phase II System Implementation, Waterways Experiment Station Terrain Analysis Radar (Project WESTAR); Final Report and Engineering Handbook	AD 465 402
	Jan 1965	Phase III Analysis of Results, Waterways Experiment Station Terrain Analysis Radar (Project WESTAR); Final Report	AD 465 403
4-100	Mar 1964	Final Report Weterways Experiment Station Terrain Analysis Gamma (Project WESTAG)	
		Purdue University	
3-108	Nov 1953	Statistical Analyses of Trafficability Data, by Paul Irick	
		Wilson, Nuttall, Razmond Engineers, Inc.	
3-112	May 1965	Observing, Analyzing, and Forecasting the State of the Ground, by N. C. Grenke	AD 616 616
		Chrysler Corporation	
3-114		A Study of the Vehicle Ride Dynamics Aspect of Ground Mobility:	
	Mar 1965	Vol. I Summary, by B. D. Van Deusen	AD 467 024
	Mar 1965	Vol. 11 Human Response to Vehicle Vibration, by B. D. Van Deusen	AD 467 025

Number	Date	Contractor and Title of Report	AD Number
3-114 (Cont)	Apr 1965	Vol. III Theoretical Dynamics Aspects of Vehicle Systems, by B. D. Van Deusen	AD 467 026
	Apr 1965	Vol. IV Field Measurements, by B. D. Van Deusen and C. H. Hoppe	AD 467 027
		9. S. Army Engineer Ohio River Division Laboratories	
3-118	Aug 1905	Photoclastic Studies for Vehicle Mobility Research, by F. M. Nellinger, J. H. Hubbard, and R. L. Peters	Aŭ 621 221
		Wilson, Nottall, Raimond Engineers, Inc.	
3-119	Nov 1964- Jun 1965	Summary of Trafficability Tests Through 1963 (in 11 volumes)	
3-120	Mar 1965	An Exploratory Study of the Effects of Terrain Surface Obstacles on Vehicle Performance; Final Draft, by G. T. Cohron and R. A. Weiner	
3-130	Dec 1965	A Dimensionless Consolidation of WES Data on the Performance of Sand Under Time Loads, by C. J. Nattall	AD 626 993
		U. S. Army Tank Automotive Center, Land Locomotion Lab.	
3-143	Jan 1965	Mobility Environmental Research Study One-Pass Program, by P. W. Haley	AD 467 165
		Milson, Nuttall, Raimond Engineers, Inc.	
3-152	Jul 1966	One-Pass Performance of Vehicles on ; ine-brained Soils, by C. J. Nuttall, C. W. Wilson, and R. A. Werner	AD 487 446
		U. S. Army Tank Automotive Center, Land Locomotion Lab.	
3-153	Feb 1966	Mobility Environmental Research Study, Mobility Testing Procedures, by R. A. Liston, T. Czako, P. W. Haley, and others	AD 800 462
		Colorado State University	
3-154	Jun 1966	Instrumentation for Vehicle Mobility Testing in a Tropical Environment, by S. J. Clark	
		FMC Corporation Ordnance Engineering Division	
3-155	Feb 1966	A Computer Analysis of Vehicle Dynamics While Traversing Hard Surface Terrain Profiles	AD 803 194
		Wilson, Nuttell, Raimond Engineers, inc.	
3-162	May 1967	Ground-Crawling: 1966; The State-of-the-Art of Designing Off-Road Vehicles, by C. J. Nuttall	AD 816 577
		Geotech, A Teledyne Company	
3-176	Aug 1967	Research, Development, and Prototype Production of an Ultraviolet Sensing Soil Moisture Meter, by J. 3. Cohen	AD 837 529

Number	Date	Contractor and Title of Report	AD Number
		Oregon State University	
M-70-1		Characterization of Water Tables in Oregon Soils with Reference to Trafficability:	
	May 1970	Volume I Data, by Larry Boersma and G. H. Simonson	AD 870 793
	May 1970	Volume II Analysis, by Larry Boersma, G. H. Simonson, and D. G. Watts	AD 870 796
		Florida State University	
Unnum- bered	Jul 1964	A Study to Develop Methods for the Analysis of the Fine Structure of Sea-Land Boundary Zones, by R. E. Stevenson and others	
		Appendix A: Photographs	
		Appendix B: Maps and Overlays	
		Appendix C: Profiles	
		Appendix D: Trafficability Data	
		Appendix E: Vegetation Data	
		Appendix F: Vegetation Data	
Unnum- bered	Aug 1965	Environmental Studies of Protected Sea-Land Boundary Zones Along the West Coast of Florida, by R. E. Stevenson and D. A. Warnke	

PART II

INDEXES

SUBJECT INDEX

```
Accelerated traffic tests
  MP 4-769
Aerial cone renetrometers
  TR 3-462-1, 3-462-2, 3-462-3, 3-462-4; MP 4-300, 4-899
Aerial photographs -- tropical regions
  TR 3-726-6
Air surcharge pressure
  MP 4-767
Aircraft -- ground flotation
  MP 4-923, 4-948
Aircraft landing areas (see also Helicopter landing zones)
  TR 3-790; IR S-70-1
Aircraft tires
  TR M-74-1; MP 4-948, M-73-16
Airfield cone penetrometer
  IR 7
Airfield construction
  MP 4-528
Airfield site selection
  MP 4-19
Airoll vehicles -- mobility
  MP 4-439, 4-513
Airphoto interpretation
  TM 3-331-6; TR 3-726-2, 3-726-3, 3-726-4, 3-726-5, 3-726-6, M-70-6;
  MP 4-19; CR 4-6, 4-20
Airphoto interpretation -- soil moisture prediction
  CR 4-12A
Amphibious vehicles -- mobility (see also Bouyant screw vehicles --
  mobility)
  TR 3-783-D, 3-808; MP 4-940, M-70-9
Articulated vehicles -- mobility
  MP 4-282, 4-412
Beach trafficability (see also Trafficability -- coarse grained soils)
  TM 3-240-13, 3-240-15, 3-240-17; MP 4-829, M-74-5, M-75-8; CR U-7/64,
  U-8/65
Bibliographies
  PSTIAC 2
Bibliographies -- dynamic bearing capacity
  CR 3-38
Buoyant screw vehicles -- mobility
  TR 3-641, M-70-5; MP 4-751
```

Cargo vehicles -- mobility TR 3-808, M-70-11-4; MP 4-322, 4-940 Climatological data MP 4-135 Coarse-grained soils -- trafficability (see also Beach trafficability) TM 3-240-4, 3-240-7, 3-240-13, 3-240-15, 3-240-17, 3-240-20; MP 4-535, 4-647, M-75-8 Computerized models -- soil moisture prediction MP 73-1 Cone penetrometers (see also Areal cone penetrometers; Penetrometers; Trafficability test instruments) TR 3-652-4; MP 4-462, M-69-7 Container handling vehicles -- mobility MP S-72-34, M-74-5, M-75-8 Craters -- mobility NCG TR 17; MP M-71-4, M-73-5, M-73-6, M-75-3 Cutting blades MP M-74-3

Desert regions -- terrain analogs TR 3-588-2 Desert regions -- terrain analysis MP 4-652, 4-687, 4-921; CR 3-112 Drawbar pull -- field tests TM 3-240-19; MP M-70-10 Dynamic bearing capacity -- bibliographies CR 3-38

Elastic loop mobility system TR M-71-1, M-74-7 Electromagnetic radiation MP 4-791 Environment bibliography PSTIAC 2 Environmental analysis -- subarctic regions CR 3-15, 3-22-1/2 Environmental analysis -- temperate regions TR 3-702 Environmental analysis -- tropical regions TR 5-625, 3-681, 3-70? Environmental effects MP M-73-15 Environmental factors TR 5-625, 3-681-1, 3-702; CR 3-15

Field tests -- drawbar pull TM 3-240-19; MP M-70-10 Field tests -- military vehicles -- trafficability (see also Mobility and specific vehicle type) TM U-9/45, 3-240, 3-240-4, 3-240-6, 3-240-10, 3-240-12, 3-240-13, 3-240-15, 3-240-17, 3-240-18, 3-414-2, 3-414-3, 3-414-4; TR 3-609 3-656-1, 3-656-2, 3-744-1, M-70-11-2; MP 4-282, 4-505, 4-535, 4-556 4-621, 4-713. 4-959, M-69-5-1; CR 3-143 Field tests -- towed vehicles -- trafficability TM 3-240-7, 3-240-15, 3-240-17 Fine grained soils -- trafficability TM 3-240-6, 3-240-7, 3-240-10, 3-240-12, 3-240-18; TR 3-699; MP 4-284, 4-441, 4-879, 4-917 Flexible pavements -- stress-strain relations MP M-69-8 Flexible wheels (see also Lunar roving vehicles -- wheels) TR M-71-6, M-73-5 Footings TR M-70-14-1, M-70-14-3 Forestry vehicles -- mobility (see also Logging vehicles -- mobility) MP 4-879, 4-959 Freeze-thaw -- soils TM 3-331-7; MP 3-482 Gamma ray spectrometer TR M-70-14-2; CR 4-100 Gamma rays -- remote sensing TR 693-3; MP 4-630, 4-823, 4-986; CR 4-100 GOER vehicles -- mobility TR M-70-3; MP 4-477 Ground flotation -- aircraft MP 4-923, 4-948 Helicopter landing zones TR M-74-1; MP 4-528, 4-766 Helicopters MP M-73-4Hydrologic geometry factors TR 3-726-5, 3-783-D, M-70-5, M-70-12-1/2Hydrologic geometry factors -- performance tests (vehicles) TR 3-783-D, M-70-5 Hydrologic geometry mapping TR 3-726-5, M-70-12-3 Infrared detectors MP 4-547 Infrared rays -- remote sensing

TR 3-693-1, 3-693-4; MP 4-547, 4-630

```
Laboratory tests -- soil property relations
  TM 3-240-1; TR 3-639, 3-652-1, 3-652-4, 3-732; MP 4-284
Land-water interface
  TR 3-783-D; MP 4-829; CR U-7/64, U-8/64
Light utility vehicles -- mobility
  MP 4-743
Logging vehicles -- mobility
  MP M-69-1
Lunar roving vehicles -- scale models
  MP M-72-3
Lunar roving vehicles -- wheels
  TR M-70-2, M-70-15, M-71-7, M-71-10-1, M-71-10-2, M-74-7; MP M-70-4,
  M - 71 - 3
Lunar soils
  TR M-70-15, M-71-1, M-71-1-10-1, M-71-10-2, M-74-7
Meetings -- mobility
  MP U-8/62, 4-670, 4-702, 4-854, 4-979, M-75-7
Meetings -- remote sensing
  MP 4-791
Meetings -- terrain analysis
  MP 4-791
Meetings -- trafficability
  MP 4-594, 4-670, U-4/67
Meterological data
  TM 3-331-1, 3-331-2, 3-331-3; MP 4-298, 4-338; CR 3-198
Microgeometry
  TR 3-790; MP M-73-7; CR 3-33, 3-155
Microwavcc - remote sensing
  TR 3-693-5
Military vehicles -- performance predictions (see also Mobility models)
  TM 3-240-20, TR M-70-3, M-70-4, M-70-7-1/2, M-70-10, M-70-11-2,
  M-70-11-3, M-70-11-4, M-71-4, M-73-1; MP M-69-5-2, M-70-7,
  M-71-4, M-71-7, M-72-2, M-74-6, M-75-4
Military vehicles -- reliability
  TR M-74-3
Military vehicles -- trafficability -- field tests (see also Mobility
  and specific vehicle type; Towed vehicles -- trafficability --
  field tests)
  TM U-9/45, 3-240, 3-240-4, 3-240-6, 3-240-10, 3-240-12, 3-240-13,
  3-240-15, 3-240-17, 3-240-18, 3-414-2, 3-414-3, 3-414-4; TR 3-609,
  3-656-1, 3-656-2, 3-/44-1, M-70-11-2; MP 4-282, 4-505, 4-535, 4-556,
  4-621, 4-713, 4-959, M-69-5-1; CR 3-143
Mobility -- airoll vehicles
  MP 4-439, 4-513
Mobility -- amphibious vehicles (see also Mobility -- bouyant screw
  TR 3-783-D, 3-308; MP 4-940, M·70-9
```

```
Mobility -- articulated vehicles
  MP 4-282, 4-412
Mobility bibliography
  PSTIAC 2
Mobility -- bouyant screw vehicles
  TR 3-641, M-70-5; MP 4-751
Mobility -- cargo vehicles
  TR 3-808, M-70-11-4; MP 4-322, 4-940
Mobility -- container handling vehicles
  MP S-72-34, M-74-5, M-75-8
Mobility -- craters
  NCG TR 17; MP M-71-4, M-73-5, M-73-6, M-75-3
Mobility -- forestry vehicles (see also Mobility -- logging vehicles)
  MP 4-879, 4-959
Mobility -- GOER vehicles
  TR M-70-3; MP 4-477
Mobility -- light utility vehicles
  MP 4-743
Mobility -- logging vehicles
  MP M-69-1
Mobility -- meetings
  MP U-8/62, 4-670, 4-702, 4-854, ^-979, M-75-7
Mobility models
  TR 3-783-B1, 3-783-B2, 3-783-C, 3-783-D, 3-783-E, 3-783-F, M-68-1-3,
  M-70-3, M-70-7-1/2, M-70-10, M-71-4, M-73-1, S-73-13, M-74-3;
  MP M-70-7, M-71-7, M-75-7
Mobility -- ocean bottom vehicles
  TR M-70-8; MP M-69-6
Mobility -- overland terrain
  TR 3-588-1, 3-588-2
Mobility -- reconnaissance vehicles
  MP U-3/74, N-74-6
Mobility research laboratories -- Waterways Experiment Station
  TR 366-1; MP 4-404, M-69-2
Mobility -- state of the art studies (see also Trafficability -- state
  of the art studies)
  TR M-71-4; MP 4-147, 4-241, U-8/62, 4-623, 4-638, 4-670, MP M-69-2;
  CR 4-16, 4-17, 3-119-1'6
Mobility -- tanks (combat vehicle3)
  TR 3-783-C, M-70-10; MP 4-101, M-75-5
Mobility -- test procedures
  CR 3-153
Mobility -- traccors
  MP 4-917
Mobility -- trucks
  TR 3 783-C, M-68-1-2, M-68-1-3, M-68-1-4; MP 4-438, M-73-14
Mobility -- utility carriers
  MP M-69-5-1, M-69-5-2, M-70-9
```

Motion resistance (see also Soil-wheel interaction; Soil-track interaction) MP 4-828 Muskeg -- trafficability TM 3-240-2; TR 3-656-1, 3-656-2, 3-744-1; MP 4-446, 4-621, 4-743 Nuclear methods (density and moisture content determination) TR M-70-14-2; MP 4-117, S-69-15; IR S-74-1 Obstacle - wheel interaction TR M-68-1-1, M-68-1-1B; MP M-68-5, M-68-7; CR 3-120 Obstacles -- tracked vehicles TR M-71-1, M-72-1 Ocean-bottom vehicles -- mobility TR M-70-8; MP M-69-6 One-pass performance CR 3-143, 3-152 Overland terrain -- mobility TR 3-588-1, 3-588-2 Penetration resistance (soils) TR 3-652-5, 3-652-6, M-70-14-1, M-70-14-3; M¹ 3-749, M-69-7, M-71-2 Penetrometers (see also Aerial cone penetrometers, Cone penetrometers; Footings; Soil strength test instruments) TR 3-652-3; MP 4-960, M-71-1, M-71-2, S-72-9 Performance predictions -- military vehicles (see also Mobility models) TM 3-240-20; TR M-70-3, M-7C-4, M-70-7-1/2, M-70-10, M-70-11-2, M-70-11-3, M-70-11-4, M-71-4, M-73-1; MP M-69-5-2, M-70-7, M-71-4, M-71-7, M-72-2, M-74-6, M-75-4 Performance predictions -- tire performance TR 3-652-7, 3-666-2, 3-666-3, 3-666-4, 3-666-5, 3-666-6, 3-666-7, 3-666-8, 3-670, 3-688, M-71-8; MP 4-870, M-73-16 Performance predictions -- track performance TR M-71-5-2 Performance tests (vehicles) -- hydrologic geometry factors TR 3-783-D, M-70-5 Performance tests (vehicles) -- surface composition factors TR 3-783-F Performance tests (vehicles) -- surface geometry factors TR 3-783-C, M-70-11-3, M-70-11-4; CR 3-120 Performance tests (vehicles) -- terrain factors TR M-70-3

Performance tests (vehicles) -- vegetation factors TR 3-783-B1, 3-783-B2, 3-783-E; MP M-69-5-2

Photography -- remote sensing (see Airphoto interpretation)

```
Plate bearing tests
  TR 3-652-5, 3-652-6, M-70-1; MP 3-749
  TR 3-516-1, 3-516-2, 3-516-3, 3-545-2, 3-545-4, 3-545-5, 3-652-7,
  3-666-1, 3-666-2, 3-666-3, 3-666-4, 3-666-5, 3-666-6, 3-666-7,
  3-666-8, 3-670, 3-688, 3-703, 3-729-1, 3-729-2, M-68-1, M-68-1-B,
  M-69-2, M-71-8; MP 4-230-1, 4-443, 4-469, 4-477, 4-497, 4-629,
  4-759, 4-757, 4-828, 4-835, 4-836, 4-870, 4-940, 4-942, 4-944, 4-948,
  M-68-1, M-68-2, M-68-5, M-68-7, M-70-6, M-73-2, M-73-16; CR 3-130
Pressure cells (soils)
  TR 3-545-2, 3-545-3; MP 4-230-1
Pressure - sinkage relations
  TR 3-652-2, M-70-1
Profilometers
  MP M-73-7
Radar equipment
  CR 4-96-1, 4-96-2, 4-96-3
Radar -- remote sensing
  TR 3-693-2, 3-727; MP 4-630; CR 4-96-1, 4-96-2, 4-96-3
Radio waves -- remote sensing
  MP 4-822
Reconnaissance vehicles -- mobility
  MP U-3/74, M-74-6
Reference test areas
  MP 4-921
Reliability -- military vehicles
  TR M-74-3
Remote sensing -- gamma rays
  TR 3-693-3; MP 4-630, 4-823, 4-986; CR 4-100
Remote sensing -- infrared rays
  TR 3-693-1, 3-693-4; MP 4-547, 4-630
Remote sensing -- meetings
  MP 4-791
Remote sensing -- mic owaves
  TR 3-693-5
Remote sensing -- photography (see Airphoto interpretation)
Remote sensing -- radar
  TR 3-693-2, 3-727; MP 4-630; CR 4-96-1, 4-96-2, 4-96-3
Remote sensing -- radio waves
  MP 4-822
Remote sensing -- soil moisture prediction
  TR 3-727; CR 4-96-3, 4-100
Rice fields
  TR 3-702; MP 4-602
```

```
Ride dynamics
  TR M-68-1-1, M-68-1-1B, M-68-1-2, M-68-1-3, M-68-1-4, M-70-11-4,
  M-72-1, M-73-5; MP 4-893, M-68-5, M-68-7, M-73-14, M-74-6, M-75-5,
  M-75-7; CR 3-33, 3-114-1/4, 3-155
Rigid wheels
  TR 3-565-1, 3-670, 3-729-2, M-68-2, S-74-7; MP 4-828, M-70-8
Road capability models
  TR S-73-13
Scale models -- lunar roving vehicles
  MP M-72-3
Short takeoff and landing aircraft
  TR 3-790
Slope performance
  TM 3-240-8, 3-240-17; TR M-71-6; MP 4-535, M-70-9
Snow strength
  MP M-70-2
Snow -- trafficability
  TM 3-414-1, 3-414-2, 3-414-3, 3-414-4; MP 4-282, 4-513, 4-713
Soil buildum (vehicles)
  MP 4-940
Soil classification
  CR 4-100
Soil cutting (see Cutting blades)
Soil data (see also Trafficability data)
  TM 3-331-1, 3-331-2, 3-331-3, 3-331-4, 3-331-5; MP 4-135
Soil density
  MP 4-284
Soil density measuring devices (see also Nuclear methods)
  TR M-70-14-2; MP M-71-1
Soil moisture
  MP 4-73, 4-284
Soil moisture measuring devices (see also Nuclear met'lods)
  MP 4-371; CR 3-176
Soil moisture prediction -- airphoto interpretation
  CR 4-12A
Soil moisture prediction -- computerized models
  MP 73-1
Soil moisture prediction -- remote sensing
  TR 3-727; CR 4-96-3, 4-100
Soil moisture prediction -- subarctic regions
  MP 4-135, 3-482
Soil moisture prediction -- temperate regions
  TM 3-331-1, 3-331-2, 3-331-3, 3-331-4, 3-331-5, 3-331-9; MP 4-338,
  3-482; CR 4-8-1, 4-8-2
Soil moisture prediction -- tropical regions
  MP 4-355-1, 4-355-2, 4-355-3, 4-355-4, 4-355-5, 4-355-6, 4-355-7,
  4-355-8
```

```
Soil penetration tests
  TR 3-652-3, 3-052-4, 3-652-5, 3-652-6, M-70-14-1, M-70-14-3;
  MP 3-749, 4-960, M-69-7, M-71-1, M-71-2
Soil property relations
  TM 5-331-10; TR 3-791-1; MP 4-298, 4-338, 4-838; CR 3-108
Soil property relations -- laboratory tests
  TM 3-240-1; TR 3-639, 3-652-1, 3-652-4, 3-732; MP 4-284, 4-457, 4-961
Soil property variations
  TM 3-331-8, 3-732; MP 3-749, 4-838, 4-961; CR 3-108
Soil samplers
  MP 4-371
Soil sampling
  MP 4-949
Soil stabilization
  MP M-75-8
Soil strength (see also surface soil strength)
  MP 4-238, 4-284, 4-327, 4-350, 3-428, 4-442, 4-446, 4-647, 4-950.
  M-70-2, S-70-25; CR 3-38
Soil strength maps
  MP M-70-2
Soil strength prediction
  TM 3-331-10; MP M-73-1
Soil strength relations
  TR 3-65?-3; MP 4-300
Soil strength test instruments (see Cone penetrometers; Penetrometers;
  Trafficability test instruments)
  TM 3-240-19; TR 3-639, 3-652-1, 3-656-1; MP 4-327, 4-350, M-70-10,
  M-72-5, S-72-9
Soil strength -- unsurfaced airfields
  TR 3-554; MP 4-365, 4-394, 4-769, S-70-14, S-70-24; IR S-70-1
Soil-track interaction
  TR M-71-1, M-71-5-1, M-71-5-2; MP 4-322, 4-651, M-74-1
Soil-vehicle interaction
  MP 4-362; CR 3-143
Soil-wheel interaction
  TR 3-565-1, 3-652-7, 3-666-1, 3-666-2, 3-666-3, 3-666-4, 3-666-5,
  3-666-6, 3-666-7, 3-666-8, 3-670, 3-688, 3-703, 3-729-1, 3-729-2,
  M-68-2, M-70-2, M-70-15, M-71-6, M-71-7, M-71-8, M-71-10-1, M-71-10-2,
  M-74-1, S-74-7, M-75-1; MP 4-443, 4-626, 4-651, 4-757, 4-758, 4-828,
  4-835, 4-836, 4-870, 4-940, 4-944, M-68-1, M-68-2, M-68-6, M-68-8,
  M-69-4, M-70-4, M-70-8, M-70-10, M-71-3, M-73-2, M-73-16; CR 3-130
Soils -- freeze-thaw
  TM 3-331-7; MP 3-482
State of the art studies -- mobility
  TR M-71-4; MP 4-147, 4-241, U-8/52, 4-623, 4-638, 4-670; MP M-69-2;
  CR 4-16, 4-17, 3-119-1/6
State of the art studies -- trafficability
  TM 3-240-5, 3-240-14, 3-414-1, M-71-5-1; MP 4-241, 4-441, 4-638,
  4-670, U-4/67; CR 3-119-1/6
```

- VETT WATER .

```
State of the ground
  CR 3-112
Stream crossings
  TR M-70-5, M-70-12-1
Stress-strain relations -- flexible payements
  MP M-69-8
Stress-strain relations (soils)
  TR 3-652-2; MP M-68-6, M-68-8
Stresses under tracks (see also Soil-track interaction)
  TR 3-545-3; MP 4-463
Stresses under vehicles
  MP 4-362
Stresses under wheels (see also Soil-wheel interaction)
  TR 3-545-2, 3-545-4, 3-545-5, 3-565-1, M-68-2, M-69-2, S-74-7;
  MP 4-230-1, 4-463, 4-469, 4-497, 4-629, M-68-6, M-68-8, M-70-6;
Subarctic regions -- environmental analysis
  CR 3-15, 3-22-1/2
Subarctic regions -- soil moisture prediction
  MP 4-135, 3-482
Subarctic regions -- terrain analysis
  MP 3-861
Surface composition factors
  TR 3-726-2
Surface composition factors -- performance tests (vehicles)
Surface composition mapping
  TR 3-726-2
Surface geometry factors
  TR 3-726-3
Surface geometry factors -- performance tests (vehicles)
  TR 3-783-C, M-70-11-3, M-70-11-4; CR 3-120
Surface geometry mapping
  TR 3-726-3
Surface soil strength (see also Soil strength)
  TM 3-240-19; MP M-70-10, M-72 5
Surface water
  TR 3-727
Synthalogous environment
  TR M-70-7-1/2
Synthetic soils
  MP M-71-5
Tanks (combat vehicles) -- mobility
  TR 3-783-C, M-70-10; MP 4-101, M-75-5
Temperate regions -- environmental analysis
  TR 3-702
```

```
Temperate regions -- soil moisture prediction
  TM 3-331-1, 3-331-2, 3-331-3, 3-331-4, 3-331-5, 3-331-9; MP 4-338,
  3-482; CR 4-8-1, 4-8-2
Temperate regions -- terrain analysis
  TR 3-808, M-70-6, M-70-7-1/2; MP 4-528, 4-726, II-3/74, M-74-8, M-75-4
Terra-tires
 MP 4-940, 4-942
Terrain analogs
  TR 3-702, 3-808; MP 4-829, U-3/74, M-74-8
Terrain analogs -- desert regions
  TR 3-500-2
Terrain analysis
  MP 4-652, 4-687, 4-921; CR 3-112
Terrain analysis -- desert regions
  TR 3-588-1, 3-588-2, M-70-7 1/2, M-75-4
Terrain analysis -- meetings
 MP 4-791
Terrain analysis -- subarctic regions
 MP 3-861
Terrain analysis -- temperate regions
  TR 3-808, M-70-6, M-70-7-1/2; MP 4-528, 4-726, U-3/74, M-74-8, M-75-4
Terrain analysis -- tropical regions
  TR 3-609, 3-726-1, 3-726-2, 3-726-3, 3-726-4, 3-726-5, 3-726-6,
  3-726-7, 3-726-8, 3-791-1, 3-808, M-70-7-1/2; MP 4-556, M-69-5-1
Terrain classification
  TR 5-625, 3-726-1, M-70-6; MP 4-444, 3-592, 4-652, 3-861
Terrain data (see Soil data; Trafficability data)
Terrain factor maps
  TR 3-588-1, 3-726-1, 3-726-7, 3-726-8; M-70-6, M-70-12-3; MP M-70-7,
  M-72-6, U-3/74, M-74-8
Terrain factors
  TR M-70-4, M-70-7-1/2, M-70-10; MP 4-444, 3-592, 4-602, 4-652, 4-726,
  4-829, 4-921
Terrain factors -- performance tests (vehicles)
  TR M-70-3
Terrain mapping
  TR 3-726-7, M-70-6; MP 4-444, 4-687, 4-726, 3-861
Terrain models (analytical)
  TR M-70-12-1; MP M-75-7
Terrastar locomotion concept
 MP M-68-4, M-69-4
Test plans -- trafficability
  IR U-10/61, U-1/62
Test procedures -- mobility
  CR 3-153
Thesauri
  PSTIAC 1
```

```
Tire deflection (see also Soil-wheel interaction)
  TR 3-516-1, 3-516-2, 3-516-3, 3-545-4, 3-545-5; MP 4-497, 4-750,
  M-58-5
Tire performance -- performance predictions
  TR 3-652-7, 3-666-2, 3-666-3, 3-666-4, 3-666-5, 3-666-0, 3-666-7,
  3-366-8, 3-670, 3-688, M-71-8; MP 4-870, M-73-16
Tires, pneumatic (see Pneumatic tires)
Tire test equipment
  TR 3-516-2
Tire tests (see Soil-wheel interaction; Tire performance -- performance
 predictions)
Tire tread patterns
 MP 4-942, M-70-9
Towed vehicles -- trafficability -- field tests
  TM 3-240-7, 3-240-15, 3-240-17
Towed wheels
 MP 4-626
Track performance -- performance predictions
  TR M-71-5-2
Tracked vehicles -- obstacles
  TR M-71-1, M-72-1
Traction devices
 MP 4-322
Tractors -- mobility
 MP 4-917
Traffic tests (see also Accelerated traffic tests)
 MP 4-365, 4-394
Trafficability bibliography
  PSTIAC 2
Trafficability classification
  TM 3-240-11, 3-240-14, 3-240-16, 3-240-20; TR 3-753; MP 4-442, 4-461
Trafficability -- coarse grained soils (see also Beach trafficability)
  TM 3-240-4, 3-240-7, 3-240-13, 3-240-15, 3-240-17, 3-240-20;
 MP 4-535, 4-647, M-75-8
Trafficability data (see also Soil data)
  TM 3-240-5, 3-240-16; TR 3-753, 3-791-2; MP 4-298, 4-447, 4-505,
  4-602; CR 3-108
Trafficability -- field tests -- military vehicles (see also Mobility
  and specific vehicle type)
  TM U-9/45, 3-240, 3-240-4, 3-240-6, 3-240-10, 3-240-12, 3-240-13,
  3-240-15, 3-240-17, 3-240-18, 3-414-2, 3-414-3, 3-414-4; TR 3-609,
  3-656-1, 3-656-2, 3-744-1, M-70-11-2; MP 4-282, 4-505, 4-535,
  4-556, 4-621, 4-713, 4-959, M-69-5-1; CR 3-143
Trafficability -- field tests -- towed vehicles
  TM 3-240-7, 3-240-15, 3-240-17
Trafficability -- fine grained soils
  TM 3-240-6, 3-240-7, 3-240-10, 3-240-12, 3-240-18; TR 3-639;
  MP 4-284, 4-441, 4-879, 4-917
```

Trafficability mapping TM 3-240-14; MP 4-19, 4-461 Trafficability maps MP 4-101 Trafficability -- meetings MP 4-594, 4-670, U-4/67 Trafficability -- muskeg TM 3-240-2; TR 3-656-1, 3-656-2, 3-744-1; MP 4-446, 4-621, 4-743 Trafficability prediction (see also Soil moisture prediction; Soil strength prediction; Water table prediction) TM 3-240-14, 3-331-6, 3-331-7; TR 3-791-1; MP U-4/67; CR 4-6, 4-20 Trafficability -- snow TM 3-414-1, 3-414-2, 3-414-3, 3-414-4; MP 4-282, 4-513, 4-713 Trafficability -- state of the art studies (see also Mobility -- state of the art studies) TM 3-240-5, 3-240-14, 3-414-1, M-71-5-1; MP 4-241, 4-441, 4-638, 4-670, U-4/67; CR 3-119-1/6 Trafficability test instruments TM 3-240-3, 3-240-13; MP 4-441, 4-463 Trafficability -- test plans IR U-10/61, U-1/62 Transportation MP M-73-15 Tropical regions -- aerial photographs TR 3-726-6 Tropical regions -- environmental analysis TR 5-625, 3-681-1, 3-702 Tropical regions -- soil moisture prediction MP 4-355-1, 4-355-2, 4-355-3, 4-355-4, 4-355-5, 4-355-6, 4-355-7, 4-355-8 Tropical regions -- terrain analysis TR 3-609, 3-726-1, 3-726-2, 3-726-3, 3-726-4, 3-726-5, 3-726-6, 3-726-7, 3-726-8, 3-791-1, 3-808, M-70-7-1/2; MP 4-556, M-69-5-1 Trucks -- mobility IR 3-783-C, M-68-1-2, M-68-1-3, M-68-1-4; MP 4-438, M-73-14 Twin wheels TR M-71-8

Unsurfaced airfields -- soil strength
TR 3-554; MP 4-365, 4-394, 4-769, S-70-24; IR S-70-1
Unsurfaced roads
MP M-74-7
Unsurfaced runway performance and evaluation
MP 4-365, M-73-7
Utility carriers -- mobility
MP M-69-5-1, M-69-5-2, M-70-9

```
Vegetation factors
  TR 3-726-4
Vegetation factors -- performance tests (vehicles)
  TR 3-783-B1, 3-783-B2, 3-783-E; MP M-69-5-2
Vegetation mapping
  TR 3-726-4
Vehicle classes
  TM 3-240-9
Vehicle cone index
  TM 3-240-18; MP M-73-4
Vehicle design
  TR M-70-11-2; MP 4-702, 4-854, 4-979, M-72-2; CR 3-162
Vehicle test instruments
  TR 3-783-A; CR 3-154
Visibility
  TR 3-783-E
Walking speed
  MP 4-950
War games
  MP M-75-4
Water content determination (soils)
  MP 4-73
Water table prediction
  TM 3-331-9; CR M-70-1-1, M-70-1-2
Waterways Experiment Station -- mobility research laboratories
  TR 3-666-1; MP 4-404, M-69-2
Wheeled-tracked vehicles
  MP M-74-1
Wheels -- lunar roving vehicles
  TR M-70-2, M-70-15, M-71-7, M-71-10-1, M-71-10-2, M-74-7; MP M-70-4,
 M-71-3
X-rays
```

MP S-70-25

PERSONAL AUTHOR INDEX*

Addor, Eugene E. TR 3-726-4; MP 4-687 Ahlvin, Richard G. MP 4-528, 4-923 Al-Hussaini, Mosaid M. TR S-74-7 Anderson, Vernon H.** TR 3-726-6 Ansted, G. Wayne** TR 5-625

Barber, Victor C. TR S-73-13 Bassett, John R. TM 3-331-9; MP 4-355-2, 4-838 Benn, Bob O. TR 3-783-A Blackmon, Claude A. TM 3-414-4; TR 3-462-3, 3-783-B-1, 3-783-B-2, 3-783-C, 3-783-D, 3-783-F, M-70-10; MP 4-949, M-71-4, M-73-6, U-3/74 Bohnert, William P., Jr. MP 4-355-7, M-70-2 Boyd, Conor W. ** MP 4-647 Broughton, Jerald D. TR 3-681-1, 3-726-4 Brown, Donald N. MP 4-923, S-72-34, M-73-16 Burke, Hubert D. MP 4-338, 4-371 Burns, Cecil D. TR 3-554; MP 4-394 Burns, James R. TR 3-726-1

^{*} Authors of contract reports are not included.

^{**} Non-WES employee

Carlson, Charles A.

TM 3-331-4, 3-331-5, 3-331-8; MP 4-355-7, 4-594
Chou, Yu-Tang

MP M-69-8, M-70-6, M-71-2
Clark, Andrew A.

MP S-72-34
Collins, John G.

TM 3-331-10; TR 3-791-1, 3-791-2
Compton, Joseph R.

MP 4-444
Czako, Tibor F.**

TR 5-625

Davis, Billy R. TR 3-693-1, 3-727 Pecell, Joseph L. TR M-70-11-3; MP M-69-5-2 Del Mar, David B. TR 3-681-1 Desmaris, A. Paul TR M-70-12-1/3 Dornbusch, William K., Jr. TR 3-726-3, 3-726-7 Dugoff, Howard** TR M-73-1 Duke, Leiland M. TR 3-588-2 Durham, Gary N. MP M-75-8

Fife, Katherine S.
TR M-70-12-1/3
Finelli, Joseph P.**
TM 3-414-1
Foster, Charles R.
MP 4-147
Freitag, Dean R.
TM 3-240-13; TR 3-516-3, 3-545-3, 3-670, 3-688, M-70-2; MP 4-443, 4-462, 4-463, 4-469, 4-535, 4-623, 4-629, 4-651, 4-750, 4-835, 4-836, 4-854, 4-959, 4-960, M-69-6, M-69-7, M-70-4

Fenwick, William B.

IR 7

^{**} Non-WES employee.

Friesz, Richard R. TR M-70-12-1/3 Frost, Robert E.** TR 3-726-6

Garrett, Edgar E. TR 3-726-5; MP 4-528, 4-556, 4-829 Gilbert, Paul A. TR S-74-7 Grabau, Warren E. TM 3-331-6; TR 5-625, 3-726-1, M-70-12-1/3; MP 3-592, 4-652, 4-687, 4-921, M-70-7 Green, Andrew J., Jr. TR 3-516-1, 3-516-2, 3-545-4, 3-545-5, 3-552-1, 3-666-2, 3-666-4, 3-666-5, 3-790, M-70-2, M-70-14-1, M-70-14-3, M-70-15, M-71-1, M-71-7, M-71-10-1; MP 4-327, 4-350, 4-469, 4-497, 4-629, M-68-1, M-68-7, M-69-2, M-70-4, M-71-3, M-71-5, M-73-15 Green, Charles E. TR M-70-5, M-74-1; MP M-73-5, M-73-6, M-75-3 Green, John E. TR 3-545-3; MP 4-362

Hammitt, George M., II MP S-70-14; IR S-70-1 Harden, Herbert W.** TR 5-625 Harrison, William L.** NCG TR 17 Hicks, Thomas E. MP 4-355-6Hill, Webster J. MP 4-948 Horton, Jerold S.** TM 3-331-4, 3-331-5 Hughes, bernard C.** NCG TR 17 Hutto, Thomas D. MP M-69-5-2 Hvorslev, Mikael J. TR M-70-1; MP 3-428, S-72-9

^{**} Non-WES employee.

Ingram, Windell F. TR M-73-5 Janosi, Zoltan J.** MP 4-651 Johnson, Philip L.** TR 3-726-6 Kennedy, James G. TM 3-240-18, 3-240-20; TR 3-462-4, 3-702, 3-791-1, 3-791-2; MP 4-355-6, 4-602 Keown, Malcolm P. TR 3-783-A Knight, Sterling J. TM 3-240-13, 3-240-14, 3-240-16, 3-331-7, 3-414-2; TR 3-462-1, 3-462-2, 3-462-3, 3-641, 3-693-1; MP 4-147, 4-238, 4-241, 4-284, 4-327, 4-362, 4-404, 4-441, 4-442, 4-447, 4-457, 4-461, 4-462, 4-463, 4-497, 4-535, 4-547, 4-623, 4-638, 4-647, 4-702, 4-751, 4-838, 4-854, 4-899, 4-949 Kolb, Charles R. TR 3-588-1; MP 3-482, 3-861 Kraft, Leland M. MP 4-944 Krinitzsky, Ellis L. MP S-70-25 Krumback, Arthur W., Jr. MP 4-371 Lacavich, Richard J. MP S-72-34 Ladd, Donald M. MP S-70-24 Lanz, Larry J. MP 4-767 Larson, David E.** MP 4-135

TR 3-693-4

Lavecchia, Nicholas J., Jr.

^{**} Non-WES employee.

LeFlaive, Etienne M.

TR 3-729-1, 3-729-2; MP 4-758, M-68-2

Leighty, Robert D.**

TR 3-726-6

Lessem, Allan S.

TR M-68-1-1, M-68-1-2, M-72-1, M-74-3; MP M-68-5, M-68-7, M-72-3

Link, Lewis E., Jr.

MP M-72-4, M-73-7

Lipscomb, Ernest B.

TR 3-693-1; MP 4-547, 4-630

Lundien, Jerry R

TR 3-693-2, 3-693-3, 3-693-5, 3-727

Maxwell, Audley A. MP 4-394 McDaniel, Alvin R. TM 3-331-8; MP 4-355-3, 4-355-4, 4-355-5, 4-355-8, 4-838 McRae, John L. TR 3-545-4, 3-666-1; MF 4-626, 4-638, 4-828, 4-870 Meltzer, Klaus -J. TR 3-652-4, M-70-2, M-70-15, M-71-1, M-71-8, M-71-10-1, M-71-10-2, M-74-7; MP M-70-4, M-71-1, M-71-3, M-73-2Meyer, Marvin P. TM 3-240-16, 3-331-9; TR 3-732, 3-753; MP 4-355-7, 4-442, 4-461, 4-743, 4-961, M-70-2, M-73-1; PSTIAC 2 Miles, Robert D.** TM 3-331-6 Murphy, Newell R., Jr. TR 3-545-4, 3-545-5, 3-652-1, 3-652-2, 3-666-6, 3-783-C, M-68-1-B, M-68-1·3, M-70-11-4, M·72-1, S-73-13; MP 4-629, M-68-1, M-75-5

Nikodem, Hans J. TR 3-693-4; MP 4-822 Nuttall, Clitford J., Jr. TM 3-414-1; TR M-71-4, M-73-1

Orvedal, A. Clifford** TR 5-625

المائدة المستحديدة والمتحدر والمتحد والمتحدد والمتحدد والمتحد والمتحدد والم

^{**} Non-WES employee.

```
Palmer, Halsey L.
  TM 3-240-13
Parks, Judith A.
 MP M-71-/
Patin, Thomas R.
  TR 3-466-7, M-75-1; MP M-72-5
Paul, Roger**
 NCG TR 17
Poplin, Jack K.
  MP 3-749
Poulin, Ambrose 0.**
  TR 3-726-6
Powell, Conway J.
  TR 3-666-1, 3-666-2
Radforth, Norman W. **
  TR 3-656-1, 3-656-2
Randolph, Donald D.
  TR 3-783-B-2, M-70-4, M-70-7-1/2; MP M-73-15, U-3/74, M-74-8
Reinhart, Keith G.**
 MP 4-117
Richardson, Boone Y.**
  MP 4-959, M-69-1
Rinker, Jack N. **
  TR 3-726-6
Robinson, James H.
  TM 3-240-19; MP M-68-4, M-69-1, M-69-4, M-74-7, M-75-5
Rone, Carlton L.
  TR 3-462-3
Rosser, Thomas B., III
  MP S-69-15
Rula, Adam A.
  TM 3-331-6, 3-414-2, 3-414-3, 3-414-4; TR 4-609, 5-625, 3-808, M-70-4,
  M-70-10, M-70-11-4, M-71-4, M-73-1; MP 4-282, 4-300, 4-322, 4-355-1,
  4-439, 4-441, 4-446, 4-854, 4-950, M-69-5-2, M-71-4, M-73-15, M-74-7
Rush, Edward S.
  TM 3-240-15, 3-240-17, 3-240-18, 3-240-19, 3-414-2; TR 3-641, 3-656-1,
  3-656-2, 3-702, 3-744-1, 3-790, M-74-1; MP 4-117, 4-284, 4-298,
  4-355-1, 4-355-2, 4-371, 4-412, 4-438, 4-439, 4-477, 4-505, 4-556,
  4-751, 4-766, 4-879, 4-917, 4-940, 4-950, M-68-4, M-69-5-1, M-70-9,
  M-70-10, S-72-34, M-73-4, M-74-5, M-75-8
```

^{**} Non-WES employee.

Schreiner, Barton G. TR 3-609, 3-656-2, 3-744-1, 3-808, M-70-5, M-70-11-2-1; MP 4-621, 4-713, M-70-9, M-73-14, M-74-6, M-75-4 Shamburger, John H. TR 3-588-1, 3-588-2, 3-681-1, 3-726-1, 3-726-5, M-70-6; MP 4-726, 3-861 Shockley, Woodland G. MP 4-547, 4-893 Smith, Jerry L. TR 3-639, 3-652-1, 3-703; MP 4-757, 4-942 Smith, Margaret H. TR 3-791-1, 3-791-2; MP 4-355-8, M-73-1 Smith, Mary E. TR 3-516-3, 3-545-2, 3-565-1; MP 4-750 Smith, Norman H. TM 3-331-7; MP 4-513 Smith, Robert P. TR M-70-5; MP M-69-1, M-69-4 Stinson, Beryl G. TR 3-641, 3-783-D, 3-783-E, M-70-3, M-70-10; MP 4-751, 4-917, M-70-7 Stoll, Jack K. TR 3-783-B-1, 3-783-D, M-70-4, M-70-10; MP M-70-7, M-71-7 Swanson, Gary D. TR M-74-7, M-75-1 Switzer, Gerald G. TR M-68-1-4; MP M-69-2

Temple, Robert G.
MP 4-879
Thompson, Allen B.
TR 3-545-2; MP 4-230-1
Tobiaski, Robert A.
MP 4-135, 4-355-2
Turnage, Gerald W.
TR 3-652-3, 3-652-5, 3-652-6, 3-652-7, 3-666-4, 3-666-8, M-71-5-1, M-75-5-2; MP M-69-7, M-73-16
Turnbull, Willard J.
MP 4-338, 4-394, 4-443, 4-447

Van Lopik, Jack R. MP 4-444, 3-482

Watkins, James E. MP 4-948 Webster, Steve L. MP S-69-15; IR S-74-1 West, Harold W. MP M - 75 - 4Wiendieck, Klaus W. TR M-68-2, M-69-2, M-70-8, M-71-6; MP M-68-6, M-68-8, M-69-6, M-70-8 Williamson, Albert N., Jr. TR 3-693-4, 3-727, M-70-14-2; MP 4-823, 4-986 Willis, William G. TR M-70-12-1/3 Willoughby, William E. MP M-73-14, M-74-1, M-74-6 Wismer, Robert D. TR 3-666-1, 3-666-3 Womack, Loren M. MP 4-365, 4-769 Woods, Harry K. TR M-70-6; MP 4-726, 3-861 Wright, Robert C. TR 3-726-1

CORPORATE AUTHOR INDEX

Chrysler Corporation CR 3-114-1/4 Colorado State University CR 3-154 Cornell University CR 3-15

FMC Corporation, Ordnance Engineering Division CR 3-33, 3-155 Florida State University CR U-7/64, U-8/65

Geotech, Teledyne Company CR 3-176

Illinois, University of CR 3-38

Oregon State University CR M-70-1-1, M-70-1-2

Purdue University CR 4-6-1/6, 4-12A, 4-20, 3-108

Texas Instruments, Inc. CR 4-96-1, 4-96-2, 4-96-3, 4-100

- U. S. Army Engineer Ohio River Division Laboratories CR 3-118
- U. S. Army Tank Automotive Center, Land Locomotion Laboratory CR 3-143, 3-153
- U. S. Forest Service CR 4-8-1, 4-8-2
- U. S. Geological Survey, Military Geology Branch CR 3-22-1/2

Wilson, Nuttall, Raimond Engineers, Inc. CR 4-16, 4-17, 3-112, 3-119-1/6, 3-120, 3-130, 3-152, 3-162

REGION INDEX

```
Canada
  Manitoba, Fort Churchili
    TM 3-240-2, 3-414-4; CR 3-15
  Northwest Territory -- Eureka, Mould Bay, Alert
    MP 4-298
  Ontario, Kupuskasing
    TM 3-414-4
  Ontario, Parry Sound
    TR 3-656-1, 3-656-2; MP 4-621, 4-743
Columbia
  MP 4-355-4
Costa Rica
 MP 4-355-5, 4-355-8
France
  TM 3-240-17
Great Britain
  MP 4-19
Greenland
  TM 3-414-2, 3-414-3; MP 4-713
Mexico
  CR 3-30-1
Middle East
 MP M-75-4
Pacific Islands
  TM 3-240-15
Panama
  TR 3-609; MP 4-556
Panama Canal Zone
  TR 3-732; MP 4-355-1, 4-355-3, 4-961; IR U-1/62
Puerto Rico
  TR 3-732; MP 4-355-2, 4-355-6, 4-961; IR U-1/62
South Vietnam
```

TR 3-808; MP M-70-2

```
Thailand
  TR 5-625, 3-681-1, 3-702, 3-726-1, 3-726-2, 3-726-3, 3-726-4,
  3-726-5, 3-726-6, 3-726-7, 3-726-8, 3-732, 3-753, 3-783-B-2, 3-783-D,
  3-783-E, 3-783-F, 3-791-1, 3-791-2, M-70-4; MP 4-829, 4-961, M-69-5-1;
  CR 3-154
United States
  Alabama
    MP 4-461
  Alaska, Fairbanks
    MP 4-135
  Arkansas
    MP 4-838
  Arkansas, Crossett
    TM 3-331-9
  Arkansas, Kelso
    MP 4-602
  Arkansas, Stuttgart
    MP 4-602
  Colorado, Boulder
    TM 3-414-4
  Florida
    MP 4-829; CR U-7/64, U-8/65
  Georgia
    MP 4-461
  Hawaii
    TR 3-732; MP 4-355-7, 4-961
  Indiana
    CR 4-20
  Indiana, Lafayette
    CR 3-108
  Louisiana
    MP 4-838
  Louisiana, Crowley
    MP 4-602
  Michigan, Houghton
    TM 3-414-4; MP M-74-1
  Mississippi, Laurel
    TM 3-240-10
  Mississippi River Floodplain
    TR 3-702, 3-808, M-70-5
  Mississippi, Vicksburg
    TM 3-240-6, 3-240-7, 3-240-10, 3-331-1, 3-331-2, 3-331-3, 3-331-8;
    TR M-70-11-2-1; MP 4-766, M-74-1; CR 4-8-1, 4-8-2
```

TR M-70-11-2-1; MP M-74-7

Oregon CR M-70-1-1, M-70-1-2 Virginia TR 3-808 Virginia, Little Creek MP M-74-5

West Germany TR M-70-6, M-70-10, M-70-12-1/3; MP M-74-8, M-75-4

MILITARY BASE INDEX

Aberdeen Proving Ground, Maryland MP 4-766, M-74-6

Camp A. P. Hill, Virginia MP 4-505, 4-726 Camp Gagetowr, Canada TR M-70-3 Camp Hale, Colorado TM 3-414-4; MP 4-513 Camp LeJeune, North Carolina TM 3-240-15; MP 4-726 Camp Pickett, Virginia MP 4-726 Camp Shelby, Mississippi MP 4-726 Camp Stewart, Georgia MP 4-101, 4-528 Cherry Point MAS, North Carolina MP 4-726

Edwards Air Force Base, California MP 4-365 Eglin Air Force Base, Florida TR 3-554, 3-783-B-1, 3-783-B-2, 3-783-D, 3-783-E; MP 4-726

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MP 4-528

Fort Campbell, Kentucky
MP 4-726

Fort Greely, Alaska
MP 3-861; CR 3-22

Fort Jackson, South Carolina
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Fort Knox, Kentucky
TM-3-240-10; MP 4-726, U-3/74, M-74-6, M-74-8, M-75-5

Fort Leonard Wood, Missouri
MP 4-726

Fort McClellan, Alabama
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Fort Polk, Louisiana MP M-75-3 Fort Ruckner, Alabama MP 4-300, 4-726 Fort Wainwright, Alaska TR 3-744-1

Marshall Space Flight Center, Mississippi TR 3-783-B-1, 3-783-B-2 Meridian Naval Air Station, Mississippi MP 4-726

Pine Bluff Arsenal, Arkansas MP 4-726 Pope Air Force Base, North Carolina TR 3-554

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tables or charts suitable for use by the Ar	my and the Nav	ry. The t	ime allotted for the		
study was so short that only a limited range	e of vehicles,	soil typ	es, and soil conditions		
could be tested. In addition, the accumula and complete analysis. Therefore, the info	ted cata confo	not be s	ubjected to thorough		
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	Chief of Engineers, DA			
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13. ABSTRACT	L			
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This report describes part of a compre				
between the trafficability of soils an				
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and techniques for full-scale tests on				
scale tests, the correlations between		instruments and		
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KEYWORDS: Field tests; Military vehicles; Self propelled vehicles; Test				
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13 ABSTRACT					
The tests reported here were conducted	d to obtain a	better understanding of the			
effect of changes in moisture content	and density o	n the trafficability of a			
soil and to obtain information on the					
a wide range of soils at various mois	ture contents	and densities.			
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13 AUSTHACT					
The reconnaissance studies reported ha	ere were conducted i	obtain information			
for planning more extensive studies in					
formation on conditions (both soil and terrain) which are quite different from					
any previously tested.					
KEYWORDS: Field tests; Muskeg; Trafficability; [Fort Churchill, Canada]					
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The tests reported here were conducted stickiness indicator for use in predict this report describes studies conducted density samples and an electrically oppulls. The problem of an instrument fa method for rapidly predicting the mo and plastic limits was investigated. strumentation for soil trafficability	cting soils trafficed to develop a so perated dynamometer for measuring slippisture content with the report summary	cabil oil sa r for operin th re	Lity. In addition, ampler for obtaining reasuring drawbar ness was studied, and espect to the liquid the status of in-	
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The trafficability project calls for conducting full-scale field tests with representative self-propelled and towed vehicles to obtain data to correlate cone index, slipperiness, and stickiness with soil trafficability. Tests in controlled conditions were scheduled for five soil types ranging from a coarse and to a plastic clay. Three of the soils were found near Yuma, Ariz., and two were found near Vicksburg, Miss. This report describes the tests conducted with self-propelled vehicles in the three Yuma soils.						
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KEYWORDS: Field tests; Fine grained so vehicles; Trafficability; [Vi	ils; Military v cksburg, Miss.]				
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The trafficability test program calls for conducting full-scale field tests with representative self-propelled and towed vehicles to obtain data to correlate cone index, slipperiness, and stickiness with soil trafficability. Tests in controlled conditions were scheduled for five soil types ranging from a coarse sand to a plastic clay. Three of the soils were found near Yuma, Ariz., and two were found near Vicksburg, Miss. This report describes the tests conducted with towed vehicles in all five soil types.

KEYWORDS: Field tests; Fine grained soils; Military vehicles; Sands; Towed vehicles; Trafficability; [Vicksburg, Mississippi; Yuma, Arizona]

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13 ABSTRACT	<u> </u>			
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performance of military vehicles, both	self-propelle	and to	wed and offers a	
system for classifying vehicles based	thereon.		oned, and oxidio a	
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13. ABSTRACT						
This report describes tests conducted	with self-prope	lled vo	chicles on natural			
soil conditions at sites near Vicksbur	rg. Miss., near	Laurel.	Miss and at Fort			
Knox, Ky., during 1949 and 1950. Only	fine-grained s	oils wo	ere included in these			
tests. The 1949 test program was in t	the nature of a	pilot s	study and was con-			
ducted to determine whether the criter tions apply to natural soil conditions	la cstablished	for cor	ntrolled soil condi-			
natural soil conditions would be neede	or whether a	wide bi	ogram or tests on			
methous, and techniques, and new crite	ria if addition	al test	s were found necessary			
The tests conducted in 1950 utilized t	echniques of te	sting a	and correlation			
developed or indicated in the 1949 tes	sts and provided	additi	onal information			
concerning the effects of traffic on the strength of natural soils. A des-						
criptive account of the testing program and the test data obtained, and an						
analysis of the results are presented in this report.						
KEYWORDS: Field tests; Fine grained soils; Military bases; Military vehicles;						
Self propelled vehicles; Soil strength; Trafficability; [Fort Knox,						
Kentucky; Laurel, Mississipp						

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No. 3-240, Sixteenth Supplement,		Washington, D. C. 20315		
with same title.				
13. ABSTRACT				
The purpose of this study was to produ	ice means of est	imatin	g the trafficability	
of soils according to their identifica	ation in the Uni	fied S	oil Classification	
System described in Waterways Experime	ent Station Tech	nical	Memorandum No. 3-357,	
"The Unified Soils Classification Syst	em," dated Marc	h 1953	. The study was	
limited mainly to the analysis of traf	fficability test	s condi	ucted since 1945	
by the Waterways Experiment Station.				

KEYWORDS: Soil strength; Statistical analysis; Trafficability classification

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13. ABSTRACT		
The tests described in this report wer		
vehicles without tow loads on natural		
during the years 1951, 1952, and 1953,	, Similar tests condu	cted in 1949 and 1950
with only two vehicles on natural fine		
less than about 20 or greater *nan abo instruments and techniques for measur	out 38, nad permitted	the development or
soil and predicting the performance of		
tests reported herein was to verify the		
relations previously established, by		
a wider range of soils. The integrity		
indexes, the minimum soil strength red	uired for the operati	on of vehicles, was
also verified.	•	•

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KEYWORDS: Field tests; Fine grained soils; Military vehicles; Self propelled vehicles; Trafficability; Vehicle cone index

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13- ABSTRACT	<u> </u>				
This is an account of the first major	attempt by the	Waterwa	ays Experiment Station		
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This is an account of the first major attempt by the Waterways Experiment Station to correlate vehicle performance with measured properties of coarse-grained soils. Purpose of field testing was (a) to become intimate with mobility problems on coarse-grained soils and (b) to determine whether instruments and techniques that had been successful for defining trafficability of fine-grained soils would also be successful in coarse-grained soils. In more than 300 tests using 18 vehicles at 17 locations, 11 of which were beaches, it is demonstrated that four instruments are capable of making measurements in sands which can be correlated with slope-climbing ability of trucks when cognizance is taken of tire pressure, with about 85 percent accuracy. Of the four instruments, the cone penetrometer is selected for future studies because of its ability to determine subsurface conditions and because it also is used for fine-grained soils.

KEYWORDS: Beach trafficability; Coarse grained soils; Field tests; Military vehicles; Mobility; Trafficability; Trafficability test instruments

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13 ABSTRACT

The trafficability factors, bearing and traction capacity, are functions of shearing strength. A simple instrument, the cone penetrometer, measures an index of shear strength. Cone indexes on fine-grained soils and sands with fines, poorly drained, are related to vehicle performance, but an auxiliary test, remolding, must accompany the cone penetrometer test to predict changes in cone index under traffic. Slipperiness and stickiness cannot be measured, but can be anticipated approximately from simple soil tests. Tests with wheeled vehicles on sands showed fair correlation between maximum slope and cone index with tire pressure duly considered. Means are presented for: classifying soils from the trafficability standpoint; computing cone index required for any military vehicles; quickly estimating maximum slopes vehicles can climb, maximum tow loads, and towing forces required on various soil strengths; making actual trafficability measurements and mapping them for strategic and tactical purposes; and for estimating trafficability without contact with the soil.

KEYWORDS: Military vehicles; Mobility; Soil strength; State-of-the-art studies; Trafficability; Trafficability classification; Trafficability mapping;

Trafficability prediction

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13. ARSTRACT

Sponsored in part by U. S. Navy

Bureau of Yards and Docks

Self-propelled, towing, and towed tests of several military vehicles were conducted on coarsc-grained soils to correlate vehicle performance with strength (cone index) and moisture condition of the soil, and vehicle characteristics. Vehicle performance for self-propelled vehicles is expressed in terms of immobilizations and nonimmobilizations and ability to pull drawbar loads; for towed vehicles, in terms of towing-force requirements. Single self-propelled wheeled vehicles were tested on undisturbed coral and volcanic sands on Pacific islands, and on quartz sand (desert and beach) in the United States. Towing tests were conducted on harrowed sand at Yuna, Ariz; towed-vehicle tests were conducted on disturbed and undisturbed sand at Camp Lejeune, N. C. Principal conclusions are: (a) performance of single self-propelled vehicles can be expressed in cone index-slope climbing ability terms; (b) wet sands are more trafficable than dry-to-moist sands (c) towing ability on harroued sand slopes can be computed with reasonable accuracy from measurements obtained on level harrowed sand; and (d) towing-force requirements of wheeled trailers can be correlated with cone index and tire pressure.

Washington, D. C. 20315

KEYWORDS: Beach trafficability; Coarse grained soils; Desert regions; Field tests; Military bases; Military vehicles; Mobility; Self propelled vehicles; Towed vehicles; Trafficability; [Camp Lejeune, N. C.; Pacific Islands; Yuma, Ariz.]

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13. ADSTRACT					
A statistical analysis was made of soi	.l strength (cor	ne index	c. remolding index.		
and rating cone index), soil moisture.	drv densitv. a	and perc	cent saturation for		
soils classified according to the Unif:	ied Soil Classi	ificatio	on System (USCS) and		
U. S. Department of Agriculture (USDA)	classification	n system	a. Data were obtained		
during wet-season periods from more than	an 1300 sites l	located	principally in humid		
temperate regions of the United States.	. Soils of hig	eh- and	low-tonography		
positions were analyzed for average and	d high-moisture	e condit	tions in the wet sea-		
son. The information was used to impro	ove an existing	r scheme	for classifuing eails		
according to their trafficability. A	companison of I	icre and	I Henr evil those has		
made for the 6- to 12-in. layer of soil	le and a study	. Hae ma	do to company the tune		
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of soil in the 0- to 6-in. layer with the type in the 6- to 12-in. layer of the profile, in USDA terms. Two appendices describe data sources and test are the profile.					

KEYWORDS: Soil strength; Statistical analysis; Trafficability classification; Trafficability data

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13 ABSTRACT

Standard trafficability and special tests with 21 military vehicles were conducted on coarse-grained soils. Areas of investigation included: (a) the correlation of slope-climbing and towing force data; (b) effects of tire size, traction devices, tire treads, and wheel load; (c) vehicle performance on "honey-comb" sand; and (d) trafficability of gravel beaches. Self-propelled wheeled and tracked vehicles and one towed vehicle were tested at five locations in the United States and France. Principal conclusions tere: (a) maximum towing force of self-propelled wheeled vehicles on level sand was about 2 percent greater than maximum slope negotiable; (b) vehicle performance increased with decreases in ground-contact pressure; (c) vehicle performance was better with smooth tires than with treaded tires or the traction device tested; and (d) vehicle performance on wet sand that tended to liquefy under the vehicle load (honeycomb sand) was similar to that on fine-grained soils.

KE) WORDS: Beach trafficability; Coarse grained soils; Field tests; Military vehicles; Self propelled vehicles; Slope performance; Tires; Towed vehicles; Traction devices; Trafficability; [France]

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13 ABSTRACT				
In 1955, formulas for computing mobili-				
cone indexes (VCI), or minimum soil st	rength required	for 50-pas	ss go-no	go, for current
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heavy wheel loads, and a few convention	nal vehicles. M	ain test y	purposes	were to obtain
data to deturmine experimentally 50-pa	ss VCI for some	untested v	rehicles	and from these

In 1955, formulas for computing mobility indexes (MI) and converting them to vehicle cone indexes (VCI), or minimum soil strength required for 50-pass go-no go, for current military wheeled and tracked vehicles were reported. Subsequent trafficability tests with vehicles having construction-equipment-type tires showed that the computed VCI did not agree closely with test results. To obtain data to determine whether the MI formula for self-propelled wheeled vehicles needed modification, field tests were run with small vehicles equipped with large, high-flotation tires, very large vehicles with very heavy wheel loads, and a few conventional vehicles. Main test purposes were to obtain data to determine experimentally 50-pass VCI for some untested vehicles and from these and other test results develop an MI formula for a wide range of vehicle weights and tire sizes. Although only 16 vehicles were tested, VCI's were determined for 20 vehicle "types." To determine if VCI prediction could be improved, a statistical analysis was made on both the original and revised MI formulas using a multiple linear regression technique. General conclusions are that considerable improvement can be made in the original formula merely by using the multiple regression equation; further improvements can be made by using the revised formula; use of the revised formula. Thus, it is suggested that the revised formula be adopted. Appendix A gives the original and revised MI formulas and compared computed VCI's for some standard and experimental vehicles using the two formulas. Appendix B is a detailed analysis and evaluation of the original and revised MI formula factors by the multiple linear regression technique. KEYWORDS: Field tests; Fine grained soils; Military vehicles; Self propelled vehicles; Trafficability; Vehicle cone index

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April 1974 April 1974 Aproved for public release, distribution unlimited. 12 Sponsoning military notification and single performance capabilities in coarse-grained soils (clean sanis) and a single present this report purposes. Earlier test programs showed a need for separation of sand into two categories wet sand and dry-to-moist sand. Dry-timenthal single performance capabilities in coarse-grained soils (clean sanis) and a single present in this report, since wet sand is usually temporary naking wet-lo-moist sands only are presented in this report, since wet sand is usually temporary and strength a time-dependent variable difficult to correlate with vehicle performance. Equations are derived for predicting fine performance sizes, etc.), and gross vehicle weight (cone friez), time characteristics (inflation pressure, sizes, etc.), and gross vehicle weight (cone friez), time characteristics (inflation pressure, sizes, etc.), and gross vehicle weight required for a venile to negotiate acvel sand (vehicle one index). An equation is also derived for predicting motion resistance for wheeled wheiled (self-pri-celled type or towed trailers). The only variables in this equation are cone index and time inflation pressures. For the range of sand strength investigated, cone index does not affect performance of a fiven test kype (rigid as or engineer tractors or flexible as on high-spect tractors). As a result of the statistical studies performed to develop a sand classification system for trafficability purposes, the following conclusions are draw (a) performance of a fiven vehicle is the same frequires the same cone index and track type (rigid as or engineer tractors or flexible as on high-spect tractors). As a result of the statistical studies performed to develop a sand classification system for trafficability purposes, the following conclusions are draw (a) performance of a fiven vehicle is the same frequires the same cone index and track type (rigid as or engineer tractors or flexible as on high-spect tractors). A	5 / JTHOR(S) (First name, middle initial, last name)				
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13 ADSTRACT	L	
The investigation of soils trafficabil	ity as related to mob	ility of military
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trafficability data or the development		
tion of trafficability by ground recon		
predictions or the development of meth	ods to correlate soli	s trafficability with
weather data sufficiently accurate to	enable military planne	ers to forecast the
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construction of roadways from local on	ne development of port	table roadways and
areas. The Waterways Experiment Stati		
first two phases. This report describ	on has been assigned. or the first studies.	conducted under
phase (2), based upon the following pr		
ness very primarily with moisture cont		
factors and climate appears in order i	f forecasts of soil t	rafficability are to
be made.		-
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This is a continuation of the study reported upon the first two reports of this series. It comprises three volumes and an appendix. Volume 1, prepared jointly by the Waterways Experiment Station and the U.S. Forest Service, gives a summary and comparison of prediction methods, and an account of current work and that planted for the future. Detailed descriptions of the Forest Service prediction methods and experimental procedures used at Vicksburg are given in volume 2. Predictions developed by the Forest Service for other areas are given in volume 3 together with results of correlation studies and a description and application of the Waterways Experiment Station prediction system. Results of special studies and basic soil-moisture and weather dath are presented in the appendix. KEYWORDS: Meteorological data; Soil data; Soil moisture prediction; Trafficability				
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13 ADSTRACT	<u> </u>		
Site characteristics, soil properties, soil-maisture predictions from the 131 American soils, used in development of given. Accuracy of the prediction met predicted moisture contents to actual for which deviations were computed for 0.03 in. of moisture for the 0- to 6-in layer. Deviations for 4.5 sites with comparts averaged 0.13 in. and method of comparison, prediction relativesed to predict soil-moisture content of predicted from actual for the second first year. Present status of the propare outlined.	sites, represe the soil-moist hod was tested soil-moisture i every day had no layer and 0. omparisons of of 0.10 in. for ions developed for the next ye d year averaged ject and recomm	nting a nure pre for ever ecords, an aver 05 in. inly bef the two from on ar. Ge about	wide variety of diction method are my site by comparing Sixty-five sites age deviation of for the 6- to 12-in. One- and after-storm layers. As a second e year's record were nerally, deviations the same as for the as for future studies
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Detailed observations made in previous	sindias of sites di	et wilmit as throughout		
the United States were used to derive	overage soil-moisture	relations for use in		
applying previously developed soil-moi	Liure Content p.edic	ion machods to sites		
for which no specific data on the mois	ture regime are avail	lable. The everage		
relations were tested on 24 sites that	had been used in the	e development of pre-		
diction method, on 10 sites for which	soil strength and no:	isture data vere		
available, and on 617 sites located th	roughout the United S	States for which described		
data vere not available. Predicted an	d measured values we:	re compared, and the		
accuracy of prediction of soil moistur	e vas vithin reasonal	ole limits of error for		
well-drained soils. Appendices give t	he prediction method	developed and a sample		
of its application, describe the 617 s	ites with limited day	a used in this inves-		
tigation, and present results of speci	al studies made to in	prove the accuracy		
of the prediction method.				
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13 ABSTRACT The study reported herein is p	lart of a compr	chensive	effort bagun in
19.9 to develop techniques for estimating	ng the traffica	bility	of soil by remote means
The is devoted specifically to development	t of technique	s for a	nalyzing and interpret-
ing vertice, aerial photographs for soil			
pasis for this study, airphoto and soil	trafficability	data w	ere collected over a
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This report describes the principles and			
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tics. Procedures for airphoto analysis of trafficability are rigidly defined, and			
in example of photo interpretation is given. Pertinent photographs, data tabula-			
lions, and appendices are presented in Volume II of this report. Appendix A lists the locations in which the soil and trafficability tests of this study were con-			
dicted. Appendix B presents a summary of			
tests. Appendix C comprises nine general			
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Moisture content, density, and soil st in Michigan which are subject to perioplots with different vegetation cover: ical data from neighboring weather st showed that (a) the greater the vegeta frost's appearance; (b) the greater th the less the mean frost depth; (c) soi as frost depth increased, and decrease density followed a trend apposite to tincreased radically when soil was froz and immediately after the final thawing	ds of freezing, bare, herbace ations were rec tion density, t e vegetation de 1 moisture cont d when frost de hat of moisture	Each cous, or corded. the late ensity a tent inc ept' dec e conten il stren	area contained three hardwood. Eeteorolog Analysis of data r the date of the firs nd snow cover depth, reased significantly reased; (d) soil t; (e) soil strength gth was lowest during
KEYWORDS: Freeze-thaw; Soils; fraffica	bility; Traffic		
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Mach will ad Security Classification DOCUMENT CONTROL DATA - R & D (Security classify ation of title, budy of abstract and indexing panotation must be entaind when the overall tepott is classified, OHIGINATING ACTIVITY (Corporate author) AS HEPORT SECURITY CLASSIFICATION Unclassified U. S. Army Engineer Waterways Experiment Station Zh. GROUP Vicksburg, Mississippi ALPORT TITLE FORECASTING TRAFFICABILITY OF SUILS: Report 8, VARIABILITY OF PHYSICAL PROPERTIES OF LOESS SOILS, WARREN COUNTY, MISSISSIPP1 4. DESCRIPTIVE NOTES (Type of topol) and inclusive dates) Report 8 of a series S. AUTHORISI (First name, middle initial, last na. Charles A. Carlson Alvin R. McDaniel BEPORT DAYE 75, NO. OF REFS December 1967 77 A CONTRACT OR GRANT NO M. ORIGINATOR'S REPORT NUMBER(\$) Technical Memorandum No. 3-331, A. PROJECT NO. 1-V-0-21701-A-046. Report 8 Trafficability and Mobility Research . Task -02, Surface Mobility 95. OTHER REPORT NOISI (Any of or muchers that may be assigned this report) AD 824 443 16. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. 11. SUPP_EMENTARY NOTES 12. SPONSORING MILITARY ACTIVITY U. S. Army Materiel Command Washington, D. C. 20315 This study was to determine if the average of soil strength values obtained in a small area can be reliably applied to larger areas. Values of properties used in predicting soil strength and classifying soils were compared for areas differing in size. Six test sites in each of four loessial soil series were established, using series boundaries on soil survey maps to locate the sites. The series were Memphis and Loring in the uplands and Collins and Falays in the buttomlands. Each site had five sampling rows; each row had four sampling positions. Plots of pedologically distinct soil series were identified from field examination within sites and were used as an additional subdivision of test areas. Soit strength and moisture content data were collected on four visits, other physical property data on one visit. The four series could not be distinguished by soil strength because the cone indexes (CI's) varied wilely for any one series and the range

KEYWORDS: Loess; Soil property variations; Soil strength; Trafficability; Trafficability prediction, [Vicksburg, Mississippi]

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of CI for each series was about the same. Soils of the 6- to 12-in. layer of the uplands differed from those of the bottomlands in clay content and prasticity, but not in strength. The poorly drained Henry series and alluvial-fill soils of the uplands, as identified in the field, had the lowest CI's. Certain plots exhibited consistently different CI's for each visit than did other plots in the same series, and certain rows in the same plot showed consistently different CI's. These differences could not be explained satisfactorily in terms of soil series, or soil properties commonly used in the Unified Soil Classification System and the U. S. Drartment of Agriculture textural classification. Appendix A. includes pasic data for each site.

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3. REPORT TITLE				
FORECASTING TRAFFICABILITY OF SOILS; WATE	R TABLE STUDY	AT CROSSE	IT, ARKANSAS	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
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3. AUTHORIS) (First name, middle initial, last name)				
John R. Bassett				
Marvin P. Meyer				
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Forest Service, U. S. Department of	Washington	, D. C.	20315	
Agriculture.	1	·		
12. ADSTRACT				
The purpose of the study was to determine				
that affect high water tables, and to exp	lore meany by	which an	existing method	for

predicting soil-moisture content of the 0- to 6-in. and 6- to 12-in. layers could be modified to improve its accuracy when applied to soils with high water tables. Factors that significantly affected the initiation, duration, and periodicity of high water tables were precipitation, topographic position, depth to a relatively impermeabl soil layer, slope of ground, rate of evapotranspiration, and, where applicable, stream or river stage. A scheme for predicting daily depths to water tables was incorporated in the soil-moisture prediction method, resulting in reasonably accurate predictions of soil moisture content and soil strength.

KEYWORDS: Soil moisture prediction; Trafficability prediction; Water table prediction; [Crossett, Arkansas]

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3 REPORT TITLE			**	
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E AUTHON(S) (First name, middle initial, last name)				
John G. Collins				
S REPORT DATE	74. TOTAL NO GI	F PAGES	76. NO OF REFS	
July 1971	120		13	
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Attempts were made to establish relations letween cone index, rating cone index, and remolding index (penetrometer strength measures commonly used in soil trafficability studies) and moisture content, soil separates contents, Atterberg limits, organic matter content, and dry density. Analyses were based on 6- to 12-in. soil layer data from 95 widely varying soils. In general, the approach followed in analyzing data was to (a) express the relation between a measure of strength and moisture content for each site with one standard equation form, (b) select coefficients that would define the strength-moisture relation for each site, and (c) relate the coefficients to soil properties. Results of the analyses indicate that usually (a) strength decreases with an increase in moisture for a given soil, (b) at a given strength level moisture content increases with a decrease in grain size or an increase in plasticity but is not associated with changes in organic matter content or dry density, (c) at a given moisture content change: in strength are associated primarily with changes in clay and/or sand contents when the U.S. Department of Agriculture soil separates are considered and with plastic and/or liquid limits when the Atterberg limits are considered, and (d) the predictive power of derived strength relations is poor even though the relations are significant (5% level). Appendixes are included in which the basic data and procedures used in obtaining the data are presented.				
KEYWORDS: Fine grained soils; Soil prediction; Trafficabili			ns; Soil strength	

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3. AUTHOR(3) (First name, middle Initial, last name) C. J. Nuttall, Jr. J. P. Finelli . REPORT DATE 74. TOTAL NO. OF PAGES 75. NO. OF REFS August 1955 LA CONTRACT OR GRANT NO. DA-22-079-eng-159 A ORIGINATOR'S REPORT NUMBER(S) Technical Memorandum No. 3-414, A PROJECT NO. 8-70-05-001 Report 1 c. Trafficability of Soi's as Related to the st. OTHER REPORT NO(3) (Any other numbers that may be assigned this report) Mobility of Military Vehicles Stevens Institute of Technology, Report No. 553 18. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. 11. SUI PLEMENTARY NOTES 12. SPONSOPING MILITARY ACTIVITY Chief of Engineers, DA Washington, D. C. 20315 IS. AS. TRACT A desk study is reported which reveals that little knowledge exists in the field of relating snow conditions to vehicle performance, and that there are several vehicles and vehicle concepts capable of providing good over-snow transport. The study argues the necessity for fundamental-type research into vehicle-snow relationships by coordinated efforts of snow scientists, trafficability and mobility researchers, and automotive engineers. KFYWORDS: Birliographies; Mobility; Snew trafficability; State-of-the-art studies

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An account of tests conducted with a na Greenland during the summer of 1954 is and techniques successful in the measur soils and the prediction of vehicle pain the Greenland snow. Results are improvide mobility problems. Results we: KEYWORDS: Arctic regions; field tests, trafficability; [Greenland]	presented. All rement of the tr rformance were te conclusive because nevertheless	l data i rafficai used (w use sno encour	are shown. Instruments bility of fine-grained ith minor medifications w in Greenland did not aging.
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13- ADSTRACT		
Self-propelled, towing, and towed test		
tracked military vehicles on a variety	y of fine-grained and	wet coarse-grained
snow conditions. The 1955 tests were	conducted at various	sites on or adjacent
to a 220-mi-long, marked trail leading 1957 tests were all run at mile 30 on	from the cage out of	Ato the les cap; one
1957 tests were all run at mile 30 on to (a) correlate vehicle performance w		
an instrument that will measure snow t		
fications, and (e) distinguish snow co	onditions that permit	a vehicle to travel
from those that do not. Vehicle perfo	ormance was correlated	d with ten methods of
Leasuring snow properties; cone index	provided the best con	rrelation. All instru-
ments for obtaining snow-property data	were serviceable, b	ut some were more
efficient than others. The snow condi		
did not produce sufficient immobilisat	HORS TO ESTRULION	STRICEDILLUY ALMAGE.
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KEYNORDS: Arctic regions; Field tests;	, Military vehicles; ?	Asbility; Snow
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	Washington, D. C.	20315	
13- ABSTRACT			
A total of 39 self-propelled tests we			
Boulder, Colorado; Fort Churchill, Na and Houghton, Michigan. In addition,			
tests were conducted with tracked weh	icles at Camp Hale. Co	lorado. It was	
concluded that depth of the surgeck a			
affecting trafficability of subtretic	snow which is kept so	It by the process of	
sublimation. It is estimated that con	nventional wheeled veh	icles would not negoti-	
ate snow desper than about 25% of the			
with vehicle-performance peremeters s			
It was found that (a) ground-contact	pressure is the most i	mortant vehicle char-	
acteristic affecting vehicle performa- than in dry snow for snowpacks of the	acc, and (b) draweer p	ull le greaver la molic.	
that vehicle tests in subsectic snow	be continued and thet	the cone personantes.	
be accepted as the most practical field			
trofficability.			
KEYWORDS: Field tests: Military bases:	Milianus subistana Mat	of I days . Common	
KEYWORDS: Field tests; Military bases; trafficability; Subarctic re			
Ft. Churchill, Canada; Hough	ton, Mich.; Kapuskasing	t, Canadal	
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PROJECT TANK TRAP: A Field Eva	luation of Nuc	lear Terr	ain Barriers
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Project TANK TRAP was conduct	ted to determ	ine the car	ability of selected
tactical vehicles to traverse craters	typical of thos	e which c	ould be produced
with Atomic Demolition Munitions (AI	DM). The vei	nicles incl	uded in the test
program were the M-60 Tank, M-113	Armored Pe	rsonnel Ca	errier, and an
articulated two-unit general purpose	vehicle called	the POLE	CAT. Traffica.
bility testing of these vehicles was pe	rformed in th	e SCOOTE	CR crater, the
JANGLE U crater, and Pre-SCHOON	ER BRAVO ci	rater. The	e results of the
research project indicate that: (1) cra	iters formed	in dry soil	by the detonation
of explosives at the surface or at ver	y shallow dep	ths of burs	st (down to approxi-
mately 20 $ft/kt^{1/3.4}$ do not present a	significant tra	fficability	problems to tracked
tactical vehicles; (2) craters formed	at or near opt	imum dep	th of burst (160
ft/kt ^{1/3} . 4) in dry soil are a trafficab	ility obstacle	to tracked	tactical vehicles;
and, (3) craters formed in hard rock,	such as basa	alt, cannot	be negotiated by
tracked tactical vehicles without major assistance by heavy duty equipment,	or moduicatio	n or the cr	ater and/or
assistance by neary cuty adminment,	eitner mobile	or inea.	
KEYWORDS: Craters; Military vehicles;	Mobility; Obs	stacles; Tr	afficability; [M-60;
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13- ASSTRACT	<u> </u>		A
A specially designed spring-impact type compressed air gun into a container of strengths were varied over a wide range between penetrometer action and soil pering deflection necessary to fire the strength. The spring was then set for verify the accuracy of the settings. Cone index has a major influence on an the relationships among velocity, dece cone index of the soil appear to be corelationships permitted computation of indication of specified soil strength. computations.	I soil. Penetry ge. From the deproperties were ne penetrometer r specific soil Results of the ction of the ac- eleration, impa- consistent and re f spring size a	cometer vista collinate collinate collinate cartrical strengt crial per cot of the reasonable and defle	velocities and soil lected relationships incl and used to empute dge in soil of specified the and tests made to d tests indicated: netrometer in soil; he penetrometer, and le; the consistent ection for proper
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Knight, S. J.				
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A limited field test program demonstra penetrometer accomplished some softeni immediate vicinity of the penetrometer penetrometer versus rating cone index grained soil) appeared to be valid, in promise as an instrument for remotely	ng or remolding. Curves of parties of the measure of dicating that	g of fin enetration f the tracks	e-grained soils in the on of the aerial cone afficability of a fine all penetrometer shows	
KEYWORDS: Aerial cone penetrometers; F	ield tests; Tre	ufficabil	lity	
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	Washington, D	. C. 2	20315		
13- ABSTRACT					
An aluminum aerial come penetrometer v	ms shot from an	eir g	m into the soil at		
10 test sites encompassing four soil t	typus and a wide	range	of soil conditions.		
Results of 73 tests conducted during the winter of 1960-61 revealed that, in					
sodition to soil strength, soil type and plasticity appear to influence the depth					
of penetration of the aerial penetrometer. Curves of penetration versus three					
expressions of soil strength commonly used in trafficability studies (come index					
and rating cone index to the depth of penetration, and rating cone index in the					
for 12-in layer year dayland the there are the restriction and rating cone index in the					
6- to 12-in. layer) were developed for three soil groups, arranged according to					
low-, medium-, and high-plasticity index. It was concluded that several penetra-					
tions should be made in a given area to determine an average nonatration to					
represent the strength of that area. It is recommended that additional tests be					
made to explore more fully the usefulness eril imitations of the aerial penetrometer.					
made to explore more fully the usefuln	ness er i limitat:	ions of	tie serial		

KEYWORDS: Aerial come penetrometers; Field tests; Trafficability

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James G. Kennedy				
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	U. S. Army Materiel Command			
	Washingto	n, D. C.		
13. ABSTRACT				
An aerial cone penetrometer was dropped from	n neights or	50, 100,	150, 200, 241, 280,	
and 560 ft to determine its velocity at impo	act with the	giound su	rface. A high-speed	
motion picture camera recorded the flight of	f the penetr	ometer just	t prior to impact.	
Velocity was determined by viewing the movie	e film with	a motion a	nalyžer. A hyperbolic	
curve defines the impact velocity-height re	lation of th	e penetrom	eter used in this	
study throughout the range of drop heights :	listed above	. A stati	stical equation for	
the curve was developed from a relation esta	ablished bet	ween heigh	and velocity. The	
equation permits computation of impact velocity				
cal techniques were used to evaluate the re-	creative and	a or nerku	c of drop. Scattsti-	
from the analysis that the equation can be	extrapolated	to a heigh	nt of 1000 ft (440 ft	
greater than the maximum measured height).	The angle f	ormed between	een the tail vanes on	
the penetrometer barrel during flight affect	ts the impac	t velocity	inversely; as vane	
angle increases velocity decreases. A variation of vane angle of 43 deg produces a				
variation in impact velocity of approximately 5.0 fps and in impact force of 5 lb. This				
variation would produce little if any effect on spring deflection and no effect on the				
ability of the firing mechanism of the penetrometer to indicate the preselected soil				
strength upon impact. It is recommended that 600 ft be established as the minimum				
height from which the penetrometer be dropped. Previously determined theoretical im-				
pact forces were verified.				
Bann 44440 A4444640				
KEYWORDS: Aerial cone penetron cers, Field	tests; Traff	icability		
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3 REPORT TITLE			
PEFLECTION OF HOVING TIRES; A PILOT S	TUDY ON A 12X22	.5 TUBE	LESS TIRE
4 DESCRIPTIVE NOTES (Type of report and inclusive dates)			
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S AUTHOR(5) (Last name, lirst name, initial)			
Green, A. J.			
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3. ABSTRACT	L		
A pilot study of the deflection charac	tonictice of a	newine.	10000 5 40001000 4500
shows the shape of the tire to be gove	rned by the in	Flation	12X17'2 fine see for 1
the consistency or strength of the med	ium on which i	t operat	ics. Results of the
pilot study indicate that a comprehens	ive test progra	au shoul	d be worthwhile.
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FEVERNOR Description in a description de de de la constant de la c			
KEYWORDS: Pneumontic .ires; Tire deflec	CTOB		
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S AUTHOR(S) (Lest name, first name, (nitial)			
Green, A. J.			
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	Chief of Engineers, DA		
	Washington, D. C. 20315		
13 ADSTRACT	<u> </u>		
Five deflection gages, each consisting coupled together, were installed in a 2-1/2-ton truck, to measure both trans on the inside surface of the tire. The surfaces. Vehicle speed, number of patemperature of the air within the tire shape of a moving tire to be determined pressure, and type and condition of surfaces, temperature variations with program did not affect tire-deflection deflection decreased with repetitive to sand. Results also indicate that gage for measuring tire deflection.	12-ply rating slational and received was rundered were varied. It were varied by inface traverse in the range expatterns. The traffic on the	tire, mo otation on on as; ad, tire Test re wheel l d. At e perience c magnit silt su	ounted on a loaded al movement of points chalt, sand, and silt e pressure, and esults showed the load, tire-inflation constant inflation ed during this test tude of the tire efface but not on the
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Report 3 of a series			
5 AUTHOR(5) (Lest name, first name, initial)	·····		· · · · · · · · · · · · · · · · · · ·
Smith, H. E. Freitag, D. R.			
6 REPORT DATE	70 TOTAL NI, OF P	AGES	Th NO OF REFS
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	Washington, I). C, 2	0315
Tire deflection data were studied from test facilities with pneumatic tires a Yuma desert sand and mortar sand of va a path of points on the center line of frame of reference. Representative pl soil strength, and inflation pressure a point on the towed and powered tire. KEYWORDS: Pneumatic tires; Sands: Tire	t various infla rious strengths the tires rela ots are include on the path and	ition pr . Plot itive to id to sh	ressures operating in its are presented of a moving and a fixed low the effect of slip, spare the paths of
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Thompson, A. B.			
Smith, H. E.			
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Kiscellaneous Paper No. 4-230	hashington,		
13. \BSTRACT			
t study was conducted to determine i	he distribution	of stres	ses imparted to a soil
by a moving, pneumatic-tired vehicle	and to compare	the su	itability of threa
different types of pressure-sensing	devices for meas	uring th	iese stresses. The
effects on stresses of such variable	s as soil streng	th. tire	-inflation pressure.
vehicle speed, acceleration, deceler			
vestigated with the cells installed			
of traffic. The large (6-in. diame:	er), earth press	ure cell	was found to be the
most reliable measuring device of th	e three used in	these to	ests. Inaccuracy of
traffic alignment, variations in whe	ci load. Variati	ons in a	soil consistency and
cell movement were concluded to have	been major caus	es of th	ne discrepancies in
stresses recorded by the cells. Rec	comendations for	future	tosts. in which these
detrimental conditions would be avoi	ded are include	d.	restal an anzen these
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KEYWORDS: Clays; Pneumatic tires; Pre	ssure cells (Soi	ls); Str	ess distribution;
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STRESSES UNDER MOVING VEHICLES; TRACKE	D VEHICLES (M29	3C, D4,	and D7) ON FAT CLAY,
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Green, J. E.			
Freitag, D. R.			
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	Washington, I		
13 ABSTRACT	1		
Results of a test program to measure s moving tracked vehicles are presented. were installed at several depths and o prepared areas of fat clay, and the ar and the D4 and D7 engineer tractors, ment of pressure cells and inconsisten couraged a quantitative-type analysis; qualitative analysis of pressure distr to be feasible. Some information was tracked vehicles. It is recommended twith better-controlled soil and traffi of pressure-sensing device.	Three types of ffsets from an reas were traffic Vehicle load are tradings of a however, the tribution beneatly obtained on movement that this type of	of press intende icked by nd speed similari test res h the tr vement o of test	sure-sensing devices ed center line in y the H29C (weasel), i were varied. Hove- ity placed cells dis- sults indicated a racks of the vehicles of soil beneath moving program be continued
KEYWORDS: Clays; Pressure cells (Soils) Tracked vehicles; D4, D7, M29	; Stress distri	.bution;	Stresses under tracks;

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Report 4 of a series					
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Green, A. J.					
KcRae, J. L.					
Hurphy, N. R., Jr.	·				
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11. SUPPLEMENTARY NOTES	12 SPONSORING MILI	TARY ACT	VITY		
	U. S. Army K				
	Washington,				
13. ADSTRACT					
This report presents results of tests					
of stresses beneath several types of p					
Twenty-nine tests were performed, in w					
differing in size, shape, and construc					
surface. Five tires were tested at on					
two inflation pressures or deflections					
other and largest tire (11.00-20, 12-F deflections for each load while both r					
showed a zone of high stresses near th					
magnitude of the stresses increasing w					
sidewall stiffness. Increase in infla					
magnitude of the stress in the center					
distributed the load less evenly. It	is recommended	that:	(a) The investigation		
of interface stress distributions on u	nyielding surf	aces be	suspended until tires		
	having characteristics different from those tested become available. (b) A				
sufficient number of tests be conducte					
tire-soil interface stresses induced b	y towed and por	werea pi	semmatic Auggis 10		
soft soils.					
KEYWORDS: Pneumatic tires; Stress dist	ribution; Stres	ses unde	r wheels: lire		
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13 ADSTRACT

Measurements of the magnitude and distribution of normal stresses at the tiresoil interface of an 11.00-20, 12-PR smooth pneumatic tire towed on air-dry
mortar sand are presented. Deflection gages inside the tire measured its deflection, and pressure cells embedded in he surface of the tire measured the
stresses at the tire-soil interface. Also, pressure cells installed at several
depths within the soil mass beneath the center of the tire path measured stresses
induced in the soil mass. Results indicate that the distribution of stresses at
the tire-soil interface is related to the shape of the deflected tire and thereby
to tire load, inflation pressure, and soil strength. Peak stress in the soil
mass occurred well ahead of the axle of the test wheel, with the total load on
the wheel having the greatest influence on its magnitude. The average stress
waves for a tire-soil system such as used in this study can be expressed mathematically in terms of a Fourier series. Application of the Fourier series in
stress wave analysis is discussed in Appendix A.

KEYWORDS: Pneumatic tires; Sands; Stress distribution; Stresses under wheels; Tire deflection

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IB. ABSTRACT				
The Waterways Experiment Station participate	ed in aircraf	t operatio	nal tests conducted by	
the Air Force Operational Test Center at two	o test sites.	Eglin AFE	. Florida, and Pope	
AFB, North Carolina, which consisted of unpu	repared, sand	y soil wit	h sparse vegetation.	
Penetrometer readings obtained at the two si correlated with CBR and converted to approxi	rces delore a	nd during	the tests were	
(a) both the C-123B and C-130A can operate a	HINDO C CON VAL	on sand an	haradas with surface	
ruts as deep as 4 to 6 in.; (b) the average	soil strengt	on send so h for the	6- through 32-in death	
can be used for evaluating the load-carrying	capacity of	a sand su	bgrade: (c) increasing	
wheel loads at constant tire-inflation press	sures up to 1	16.000 1ъ	had little or no effect	
on depth of ruts; (d) increasing tire pressu	ire for a con	stant or i	ncreasing wheel load	
resulted in more severe rutting and disturbance of the sand subgrade: (e) minimum sub-				
grade strength requirements (based on average strength values for the 6- through 12-in				
depth), as determined from tests with C-123B and C-130A aircraft, were in good agreement				
with strenth requirements indicated by the previously developed CBR design curves; and (f) tentative strength criteria established by WES and ORDL for the operation of air-				
craft on unsurfaced soils are as good as can	be establish	hod from d	e operation or air-	
present time.	. me cordoll8	nen TLOM (1	are avaitable at the	
KEYWORTS: Military bases; Soil strength; Un Pope AFB, N. Carolina]	surfaced air	fields; [E	glin AFB, Fla.;	

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TESTS WITH RIGID WHEELS; TESTS IN FAT	CLAY, 1958		
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Smith, M. E.			
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3. ABSTRACY			
Results are presented of the first tes a towed rigid wheel in a fairly soft s	oil. Speed wa	s mainta	lined constant. Load
on the wheel was varied from test to t curred along each test lane. Heasurem			
deviation in static load on the wheel;			
resistance, contact pressure between t	he wheel face	and the	soil, strength (cone
index) of the soil, and stresses induc	ed within the	soil mas	s. Various relations
among the data are plotted, and expres		tical te	rms. Heasured
stresses are compared with theoretical	stresses.		
KEYWORDS: Clays; Rigid wheels; Soil-whe	al interaction	Stress	es under whosts
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Shamburger, John R.; Kolt, Charles H.			
S. REPORT DATE	74. TOTAL NO OF P	AGES	75. HO. OF REFS
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11. SUPPLEMENTARY NOTES	12 SPONSORING MLI	TARY ACT	WITY
was conducted in 1962 at the Yuma Test of terrain analysis and evaluation base relief, soil type, soil consistency, refactors of many world deserts, includin Fourteen test courses were tentatively hemsive office study of terrain factor shoser to test the mobility of the Over 1926ery of the course were obtained. That WES mapping system along nine of the Illustrations, tables, maps	Station, Arizon of on plan-profick type, and very the desert at selected at YTA maps. Reasonabland Train. Telerrain types we	a (YTA) le, slo getatio Yuma, subseq ly seve	, using a system pe occurrence, slope, n. The terrain have been mapped. quent to a compre- re routes were factor data and aerial
KEYWORDS: Desert regions; Military bas Terrain factor maps; Overland	es; Off-road mot d Train;[Project	oility; COTTER;	Terrain analysis; Yuma Test Station]

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4	AD 613 166	·	
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11. SUPPLEMENTARY HOTES	1 :- SPONSORING MILI	TARY ACT	WITY
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Speciality	Washington,		
13- ABSTRACT			
In August-October 1951, the U. S. Army Swamp Fox I, a 93-mile cross-country of Board formed the nucleus, command, and technical services team of specialists collected data on terrain, vegetation, these factors on movement of twelve ty and tracked vehicles. They also tested trafficability of Panena soils. The dare approximate and incomplete in many vet surface-soil conditions, and participant obstacles to vehicle movement. Detional viscoled vehicles early. The soil supporting the vehicles used. The instability appeared adequate. Appendix describes procedures for prepr	peration, in Particular procession of military and soils, and pos of military and instruments a late, collected arespects. Gullicularly steep, difficult going oils encountered threachts end to but her testi	raname. In agency Experiment Id observ In action In tech In t	The Transportation of for a combined of Station observers well the effects of propelled, wheeled uniques for determining adverse conditions, rivers, vegetation, of slopes were significated dropping conventionable of a used to determine the convention of the company of the com
KEYWORDS: Field tests; Military vehicle Trafficability; Tropical reg	es, Off-road mo gions;[Panama; S	obility, Swamp To	Terrain analysis; x]

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A REPORT TITLE ENVIRONMENTAL FACTORS AFFECTING GROUND MOBILITY IN THAILAND, PRELIMINARY SURVEY					
and eight appendices (A-H) in separate	Final report convolumes.	nsistin	ng of a main volume		
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	Advanced Resear Washington, D.	rch Pro	jects Agency		
guidance for a planned, longer range research program to develop and apply new and existing methods for measuring and predicting in quantitative and semiquantitative terms the effects of environmental factors on ground vehicles operating in Southeast Asia. The report is concerned specifically with the results of a field program conducted in Thailand. It presents a summary of the state of the art of measuring and predicting the effects of environmental factors on ground mobility, describes the environmental factors that affect ground mebility, presents the factor family concept and data adapted to ground-mobility purposes, and categorizes in tabular form environmental data by landscape types and subunits that occur in Thailand Estimates of the probable effects of terrain factors on the performance of highly mobile vehicles are made for each landscape subunit. The report also presents conclusions and recommendations derived from an evaluation of the investigation. Eight affordates (A-i) were also published (in separate volumes) in conjunction with triding report. Appendix A describes the results of a survey of unclassified existing data and literature. Appendices P. C. D. E. F. and G present methods of measurement and attained and graphic presentations relative to the specific terrain factor with which each is concerned, i.e. soil classification, soil trafficability, vegetation, surface geometry, hydrologic ometry, and weather and climate, respectively Appendix H presents an evaluation of the roads over which the preliminary survey test team traveled during the field data collection. KEYWORDS: Environmental analysis; Environmental factors; Orf-road mobility; Road tests (Venicles); State-of-the-art studies; Ferrain classification;					
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13- ADSTRACT			
This study was undertaken to determine			
obtained with the bevameter, the vane	shear apparatus,	the W	IES cone penetrometer,
and the triaxial shear machine to the			
a heavy clay and a lean clay, and to c			
types of strength measurements. Direction vane shear strength, cone index, press			
vane shear strength, cone index, press tests), and bevameter and triaxial she			
pressure reflect changes in soil moist			
whereas indirectly measured or derive			
and the bevameter sinkage values are m			
be correlated with each other to some	extent, except to	hat fr	riction angle apparent)
was not directly related to either of			
tost results,	<u> </u>		
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13. ABSTRACT				
The Marsh Screw Amphibian is of interest in the Army's mobility research program because of its unusual concept of locomotion which is based on the Archimedean screw. It moves by means of two counterrotating rotors which give forward and backward thrust to the vehicle. When both rotors are made to turn in the same direction, the vehicle will move laterally; however, there is no provision for steering when the vehicle is moving laterally. Trafficability tests with the Marsh Screw were performed to determine its performance on three soil types: sand, clay, and silt. Repetitive-pass tests and speed tests were conducted on clay and sand; touring tests on clay, silt, and sand; slope-climbing tests on sand; end obstacle tests on silt. For comparison, tests with an M290 weasel were conducted and performance curves from previous test programs were utilized. Appendix A presents a detailed description of the determination of mobility indexes and vehicle cone index for the Marsh Screw. Appendix B discuss as the power train system.				
EYWORDS: Buoyant screw vehicles; Piel	d tests; Mobili	ty; Tra	fficability	
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OF AN AIR-DRY SAND				
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13. ABSTRACT				
This study was undertaken to evaluate				
surements to detect and follow changes	s in sand densi	ty and t	to develop correlations	
between the various strength measureme				
axial shear apparatus; direct shear ap	pparatus; the De	evameter	, which included a	
ring shear device and circular plates				
the WES cone penetrometer. It was fou	and that the ver	ne snear	strength, the cone	
index, plate pressure, and the plate s		_	•	
tr soil density and consequently to ea				
values were derived whenever practical				
triaxial and direct shear tests are si	ignificantly lar	rger the	in the bevameter snear	
friction angles.				
KEYWORDS: Laboratory tests; Sands, So:	al density; Soi	l proper	tv relations; Soil	
strength; Soil strength tes				
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13. ABSTRACT			
A proposed technique for describing the tests and pressure-sinkage relations for Both sand and clay specimens, prepared The proposed technique, which is based hyperbola, adequately portrayed the stransure-sinkage relations usually requat shallow sinkages and another at greparameters were found to be related to test specimens. It is recommended that soils and test conditions.	from plate-pener i in the laborat i on the characterss-strain re- quired one hyper sater sinkages.	tration tory, we teristic lations rbola to Certai characto	tests was studied. The used in the study. The of a rectangular Examined. The office the relation The office the relation The office the soil

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KEYWORDS: Laboratory tests; Pressure-sinkage relations; Stress-strain relations (Soils); Trafficability

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13 ASSTRACT Three soils a fat clay, a	lean clay, and	a loessial si	ltwere tested to de-

termine the effects of penetration velocity, probe size, and probe shape on the penetration resistance of fine-grained soils. Velocities ranging from 0.0011 to 451 cm/sec were used to penetrate samples compacted at various water contents to provide soil consistencies from 103 to 1820 kN/m² standard penetration resistance. Two probe shapes were used--30-deg-apex-angle, right circular cones and flat, circular plates. Base areas of the cones ranged from 1.29 to 50.0 sq cm, and those of the plates from 9.93 to 39.70 sq cm. The relation of penetration resistance to velocity was not linear, so no constant "coefficient of viscosity" could be determined. The relation could best be described as that of a pseudoplastic mate ial. The data revealed that the size dependence of penetration resistance was coupled with the velocity effect. Data at different speeds and sizes could be grouped on a single relation simply by employing the velocity, diameter ratio as the independent variable. From the experimental data, it was concluded that the soil response could be described as the sum of a viscous component and an inertial component. An apparent threshold velocity was found below which resistance was constant, but was attributed to the effect of water migration from the stressed zone at low penetration velocities. Data for the highest velocity tested in this study were higher than predicted, but the higher values could reasonably be accounted for by considering the effects of inertia. Further tests are needed at velocities much higher than those of this report to validate a behavorial model that includes the very-highvelocity condition.

Fine-grained soils; Laboratory tests; Penetrometers; Soil KEYWORDS: penetration tests; il strength relations; Trafficability

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Relations between cone penetration resistance and relative density were developed by means of statistical analysis (correlation calculation) for three cohesionless soils: Yuma sand, mortar sand, and Bayou Pierre sand. These relations were evaluated from direct measurements of relative density and results of tests with the U.S. Army Engineer Waterways Experiment Station (WES) standard cone penetrometer. Most of the data for Yuma and mortar sands had already been obtained as part of the soil-tire performance tests previously conducted at the WES. However, several special laboratory tests in molds with both sands were conducted to control and extend the existing range of data. The results in Bayou Pierre sand were obtained from laboratory tests conducted especially for this study. The relations established between relative density and cone penetration resistance and its gradient, respectively, averaged over the O- to 15-cm depth, depend on the grain size and compactibility of the soil. The cone penetration resistance increases with increasing soil mean grain diameter and decreasing compactibility. The critical depth of penetration affects the results within the considered depth range only in loose and very loose sands. A qualitative theoretical explanation of what occurs during the penetration of a cone into a cohesionless medium is given.					
KEYWORDS: Cone penetrometers; Lab Soil penetration tests; strength; Trafficabilit	Soil pro	ests; Sa perty re	nds; Soil density; lations; Soil		
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tration velocity and plate inclination angle.

KEYWORDS: Fine-grained soils; Penetration resistance (Soils); Plate bearing tests; Soil penetration tests

inertial effects were produced in these tests. Plate penetration tests conducted horizontally at speeds to 27.35 m/sec in muddy clays at the Battelle Institute, Frankfurt, Germany, produced soil lift forces strongly influenced by inertial effects. These effects are described by an improved dimensionless lift coefficient C_L versus plate—soil numeric (π_g) logarithmic relation that effectively accounts for the influence of pene-

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MEASURING SOIL PROPERTIES IN VEHICLE MOBILITY RESEARCH	H; Report 6, RESISTANCE OF COARSE-GRAINED SOILS TO					
HIGH-SPEED PENETRATION	,					
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	Assistant Secretary of the Army (R&D) Department of the Army					
	Washington, D. C.					
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For a given probe (cone or flat plate) tested vertice	ally in air-dry sand of a given strength level. the					
curve of probe base pressure (sand penetration resist						
probe base depth departs from near-linearity as veloc	ity V ₂ increases. For these conditions, values of					
	acreasing velocity, but this pressure approaches a com-					
mon value at substantial depth (say, 15 cm) for velocity near 3 cm/sec, the slope, or gradient						
penetration resistance gradient $G_{\mathbf{x}}$ can be expressed	, of the probe base pressure versus depth curve (termed for any of a broad range of probe sizes and shapes					
l	•					
by $G_{s} = \{(G-1) \times 0.20 + (0.80 \frac{s}{7}) 1\}$ where	G is $G_{\mathbf{x}}$ measured under standard conditions (i.e. by					
a 5.25-sq-cm, 50-deg-apex-angle cone at 3.05 cm/sec)	, L is A for the standard cone, and L_{χ} is the					
Ax for the probe of interest. Expressions were all (zero base depth for the cones, 2.5-cm depth for the	so developed to describe F_Z at shallow probe depths					
	of each of these variables. Finally, a technique is					
presented for estimating the Fz versus depth curve						
2.5- to 15-cm depth range for plates, for V_{z} values	less than about 100 cm/sec and any of a wide range					
of sand strengths and probe sizes and shapes. A second	ond phase of this study determined expressions that					
describe the marked increase in sand G values cause	d by increases in sand unit dry weight 7d and/or					
moisture content. In the third phase of this study, dimensional analysis was used to develop a description of the horizontal force acting on a given cone base as the cone moves horizontally beneath the sand						
	tion of the horizontal force acting on a given cone base as the cone moves horizontally beneath the sand F_X) as a function of probe size and velocity; depth of the cone tip relative to the undisturbed sand					
surface; and air-dry sand G and 7d . A short revi						
cone penetration tests showed that these findings ag	ree with and complement results of the WES study. A					
brief summary of another study presents relatedpre						
components of force on plane blades operating horizon						
KEYWORDS: Penetration resistance	(Soils); Plate bearing tests; Sands;					
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UNDER HIGH-SPEED TIRE LOADS		6 PERFORMING ORG. REPORT NUMBER				
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Gerald W. Turnage						
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experis	ment Station	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS				
Mobility and Environmental Systems L. P. O. Box 631, Vicksburg, Miss. 391	aboratory	Project 4A061101A91D				
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Fine-grained soils Soil-wheel interaction						
Mobility numbers Tire performance						
Performance predictions						
rneumatic tires						
20 ABSTRACT (Continue on reverse side if recessary and in						
This study examined the effects of wheel speed on the performance in fine- grained soils of single pneumatic tires, full-size wheeled vehicles, and a pro- totype aircraft under several tire operational modes. Results from powered- wheel single-tire tests conducted at WES showed that the dimensionless clay-tire						
numeric $N_{cl} = (C_s bd/W) \times (\delta/h)^{1/2} \times 1/[1 + (b/2d)]$, where $C_s = standard$ cone						
C1 S						

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index, b = tire section width, d'= tire diameter, W = wheel load, and 6/h = tire deflection ratio, can be used to describe tire performance (Continued)

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20. ABSTRACT (Continued).

at speeds to at least 18 ft/sec if the value of $\begin{array}{ccc} c & \text{in} & N \\ c1 & \text{cl} \end{array}$ is adjusted to reflect viscouslike soil strength behavior caused by tire-soil interaction. Results from WES speed tests of five prototype wheeled vehicles in the field indicated that the same velocity-adjusted numeric as above (except that rating cone index RCI replaces cone index C_s) is closely related to the soil motion resistance coefficient $R_{_{\mathbf{S}}}^{}/W_{_{\mathbf{V}}}$. Data from tests conducted for the U. S. Air Force showed that for one particular combination of aircraft, running gear, and wing-rlap setting, a clay-tire numeric, $N_{c0} = (C_s bd/W) \times (\ell/h)^{1/2}$, is closely associated with the percent increase in takeoff distance required on unsurfaced clay runways as compared to that on a paved runway. From another study conducted for the A r Force, data revealed that a relation between the dimensionless drag coefficient and the Reynolds number (modified from fluid mechanics to fit the clay-tire situation) can be used to describe the combined influence of viscouslike and inertial changes in soil strength on the drag of a freerolling tire at speeds to about 150 °t/sec. For the braked-wheel operational mode, a simple method of predicting drag ratic (D/W) was developed on the basis of a reasonably stable, linear relation that exists between D/W and the rut depth coefficient (r/d) for wheel speeds to about 150 ft/sec.

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Radforth, N. W.			
Rush, E. S.			
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13 ABSTRACT			
A pilot program of a limited number of	trafficability	tests wi	ith four vehicles (a
20-intrack Weasel, a 10-intrack Wea	sel, a Woter Bu	ffalo, s	and a Dinch) was con-
ducted in eight confined muskeg areas i	n Ontario, Cana	ia. Fre	quent failures of
mechanical components of the vehicles b	ecause of muske	cross:	ing the track systems
hampered the test program. Results sno have promise as tools for measuring tra	ned the cone be	16610851	men change and seem to
(with 20-in-wide tracks) could negotiate	o the mojetively	MISKEE.	The standard weasel
bilized on the floating-mat type (mechan	c oue termination	y dense	muskeg but was into-
with crustal. In in saids tracks had as	rear laithtes e	canasa,	. The Measer equipped
with special, 10-inwide tracks had oc	casional dillic	icty eve	n in the more consoil.
dated bogs. Towing abilities of the We	asets were noar	is imak	of their weights. In
addition to the self-propelled and town	ng tests with the	ne Weas.	is, four self-propel-
led tests were conducted with a Water B	urialo, and two	with a	Dinah. On a qualita-
tive basis, ranges of trafficability po-	tential were di	boa osos	in the tests, and
these were tentatively related to charac	cterisite diffe	rences i	n peat, cover, and
terrain-water relations. Additional te	sts need to be	conducte	d in the same areas
with a range of vehicle types before ac	ceptable correla	itions t	etween vehicle persor-
mance and muskeg type and condition can	oe expressed.		
KEYWORDS: Field tests; Military vehicle			
instruments; Tracked vehicles		/; [Ui n ah	; rarry Sound, Untario,
Canada; Water Buffalo; Weasel	J		
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Rush, E. S. Schreiner, B. G.			
Radforth, N. W.			
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13 ABSTRACT	<u> </u>		
A program of trafficability tests with confined muskeg areas in Ontario. Cana			

A program of trafficability tests with 10 tracked vehicles was conducted in nine confined muskeg areas in Ontario, Canada. One hundred and forty-one single self-propelled tests, 8 towing tests, 5 towed-vehicle tests, and 12 torque-requirement tests were conducted. Results showed that vehicle performance on a self-propelled (go-no go) basis can be correlated reasonably well with cone index of muskeg. Vehicle weight appears to be the most significant vehicle factor affecting performance. Cone index values in the various muskeg surface cover formulas varied widely, being influenced principally by the quantity of water present. The data obtained did not reveal even a general relation between muskeg surface cover formula and cone index. Anomalies occurred in relations of vehicle performance to cone index of muskeg, suggesting that although cone index appears to be a prime indicator of muskeg trafficability, it will be necessary to examine other physical properties of the medium as well.

KEYWORDS: Field tests; Military vehicles; Mobility; Muskeg; Tracked vehicles; Trafficability; [Parry Sound, Ontario, Canada]

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13 ABSTRACT			
This report presents introductory and	background info	ormation	on research being
conducted on performance of soils unde			
test facilities and techniques used by	the Army Hobi	ity Res	earch Branch, Mobility
and Environmental Division, U. S. Army	Engineer Water	rways Ex	periment Station. It
also includes a complete list of defin		lity ter	ms with particular
reference to those concerning pneumati	c tires.		
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KEYWORDS: Glossaries; Hobility; Pheum	atic tires; Soi	1-wheel	interaction; Test

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13 AUSTRACT			
A total of 709 tests performed with si	ngle pneumatic	tires i	n Yuma desert sand
placed in novable sand bins in the lab presented to show the correlations obt	oratory are an	alyzed.	Basic plots are
Representative cross plots are include	d to show the	riigivica effects	of time width and
diameter and to illustrate the relativ	e effectivenes	of the	various tires tested
Initial steps in the development of a	numeric that w	ill defi	ne a single relation
between dependent and independent vari	ables for all 1	tires an	d test conditions
are reported.			
KEYWORDS: Laboratory tests; Mobility no	mbers; Perform	ance pre	dictions; Pneumatic
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S AUTHOR(S) (Leat rame, first name, initial)		 	
Wismer, Robert D.			
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This report analyzes the results of 184	multiple_page	teete v	ith a single, smooth.
pneumatic tire (9.00-14, 2-PR) in a fat			
tests were performed using a wide range	of tire loads,	tire d	eflections, and soil
strengths. Some of the tests were cond performance. Pasic plots of the data (ucteu to study	the inf	luence of speed on ne independent variable
with all other independent variables he	ld constant) sh	ow the	relative effect of each
independent test variable on tire performance	rmance. Scatte	r of the	e pull and torque data
points was found to be quite large for showed that a difference in soil streng			
of the soil mass was the probable cause			
cessing techniques subsequently produce	d more uniform	soil co	nditions and virtually
eliminated this scatter in the later te			
adequate to represent the forces and more operating at small sinkages in a soft of	ments on a towe lay.	a or bo	sered busingsts size
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KEYWORDS: Clays; Laboratory tests; Performance interaction; Tire performance.	rmance predicti mance: Traffica	ons; Problem	eumatic tires; Soil-
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Washington, D. C. 13 ABSTRACT This study examined the effects of tire deflection, tire geometry, wheel load, and soil strength on the performance of coarse-grained soils subjected to moving tire loads. Mathematical expressions were developed that combine the independent tire-soil and system parameters and relate them to the performance coefficients. A combination of independent parameters, $\frac{C(bd)^{3/2}}{W} \times \frac{\delta}{h}$, was developed from single-wheel laboratory tests. This expression, referred to as the sand mobility number, is shown to account for the combined effects of soil strength (G), tire section width and diameter (b and d, respectively), wheel load (W), and tire deflection (δ/h) on wheel performance as measured by the performance coefficients. A multiple-pass analysis was conducted to illustrate that performance on the secont and third passes also could be related to the sand mobility number, although the relation was not the same as that for the first pass. It was shown in a similar fachion that the performance of vehicles on coarse-grained soils could be predicted using a relation based on the sand mobility number.					
KEYWORDS: Dimensional analysis; Mobility Pneumatic tires; Sands; Soil- Trafficability	y www.bers; Peri -wheel interacti	formance lon; Tire	predictions; e performance;		

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18. ABSTRACT	·		
A study was made of the effects of various	testing tech	naiques on	the performance of
pneumatic tires operating in an air-dried	desert sand a	and a nest	ly saturated fat clay.
Tests employing both controlled-slip and co	ontrolled-pu	ll techniq	ues were conducted with
single-wheel dynamometer carriages. The re	esults are p	resented in	n the form of graphs
with emphasis placed upon the pull-slip and	d torque-sli	relation	For the conditions
tested, wheel performance was found to be	independent (of testing	techniques, with one
exception; consistent differences were not	ed between th	ne results	of programmed-
increasing- and programmed-decreasing-slip	tests. How	ever, this	disagreement occurred
only for a narrow range of slip (approximate	tely -10 to ·	F10%). Ca:	reful and complete
analysis of a dynamic test system must be	nade to deter	mine the	forces that actually
represent the wheel performance. A brief	analysis of	the horizon	ntal forces acting on
the test dynamometers is given to emphasize	e this point	, particula	arly with regard to
differences between pull-slip and drawbar			
cause of the inability always to attain a s	stable condi	tion in co.	ntrolled-pull tests,
controlled-slip tests are better fo. defin	ing pull-sli	relation:	••
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KEYWORDS: Clays; Laboratory tests; Perform	ance predict	ions; Pneu	matic tires; Sands;
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Unclassified Security Classification DOCUMENT CONTROL DATA - R & D (Security classification of title, body of abstract and indexing annotation must be ent d when the everall report is classified) ORIGINATING ACTIVITY (Corporate author 24. REPORT SECURITY CLASSIFICATION U. S. Army Engineer Waterways Experiment Station Unclassified Vicksburg, Mississippi 26. GROUP REPORT TITLE PERFORMANCE OF SOILS UNDER TIRE LOADS; Report 7, EXTENSION OF MOBILITY PREDICTION PROCEDURES TO RECTANGULAR-CROSS-SECTION TIRES IN COARSE-GRAINED SOIL 4 DESCRIPTIVE HOTES (Type of report and inclusive dates) Report 7 of a series AUTHOR(S) (First mage, middle initial last mage) Thomas R. Patin S REPORT DATE A TOTAL NO. OF PAGES 78. NO OF REFS April 1972 35 10 . CONTRACT OR GRANT NO A. ORIGINATOR'S REPORT NUMBER(S) Technical Report No. 3-666, Report 7 A. PROJECT NO 1T062103A046 b. OTHER REPORT NO(5) (Any other numbers that may be seeign .Task 03 AD 741 770 16. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited II SUPPLEMENTARY NOTES 2. SPONSORING MILITARY ACTIVITY Directorate of Research, Development and Engineering, U. S. Army Materiel Command Washington, D. C. The study reported herein was conducted to determine whether the sand mobility number that had been developed for circular-cross-section tires operating in a particular coarse-grained, air-dry soil could be used to predict the performance of rectangularcross-section tires in the same or a second coarse-grained, air-dry soil. Five rectangular-section tires were tested in each of two coarse-grained soils, a desert sand from Yuma, Arizona, and a mortur-type sand from a river deposit near Vicksburg, Mississippi. The data collected in these tests were compared with relations pr viously developed from tests with circular-section tires in air-dry Yuma sand. Analysis of

· Series Statement of the Series

test results showed that the existing sand mobility number can be used to predict the performance of rectangular-section tires in both test sands.

KEYWORDS: Laboratory tests; Mobility numbers; Performance predictions; Pneumatic tires; Sands; Soil-wheel interaction;

Tire performance; Trafficability

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13 ABSTRACT			
Data from a very large block of previously collected			
selected field tests were examined to: (a) determin			-
$\frac{G(bd)^{3/2}}{V} \cdot \frac{\delta}{h}$ and for clay $\frac{Cbd}{V} \cdot \left(\frac{\delta}{h}\right)^{1/2}$ could be a	mproved, and (b)	extrapolate	laboratory relations to
field relations for full-size vehicles. (In these t	eras C and G	are penetra	tion resistance and pene-
tration resistance gradient, respectively, for clay			
is section height; δ is tire deflection; and W i			
for the content of t	the basic predi	ction terms.	These basic terms predict
ormensionless tire periormance coefficients puti/ion	T (L/m) Printske	/ulameter (z)	/u/, torque/lond - active
radius (M/Wr), all at 20 percent slip (near maximum	rull), and towe	d force/load	(P _T /W) quite well for many
sizes and shapes of pneumatic tires in the laborator			
both sand and clay predict the performance of tires than the basic terms, but predict performance of con-	or wheels of ver ventional pneuma	y small 3/h tic tires le:	values more accurately
sionless terms (1500,/V _{sh}) ^{1/2} and [0 1(V _v /b)/(V _s /c)	170.092	********	he basis word(stion terms
for sand and clay, respectively, the P/W versus pr single lines for wheel translational velocities (V_)	ediction term re in the <1 to 18	ft/sec range	erectively collapsed to
velocity, V is standard penetration velocity, and			O.,
•	•		
<pre>diction terms can serve as the base for predicting w cone index) is substituted for C in the term for c</pre>			
are examined in detail, and examples illustrate seve			
KEYWORDS: Dimensional analysis; M	obility nu	mbers; P	erformance pre-
dictions; Pneumatic tir	es; Soil-w	heel into	eraction; Tìre

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4 DESCRIPTIVE NOTE) (Type of report and inclusive deten)			
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Wheel performance data from almost 300 cipally these tests were conducted on frictional and nonfrictional. Rigid-t sented. The force required to tow traby traction wheels are considered to be analyzed to show the effects of load, performance. Among the tire geometry deflection, carcass construction, and formance varied systematically with the is described closely by mathematical e groups load and soil strength always he In frictional soils tire diameter, wid while tread pattern and carcass constructive diameter, width, and deflection he very important under particular cirrived from dual tires and for tractions	two general soil gired and pneumatic insport wheels and se measures of peritire geometry, and variables examined tread pattern. It is test variables, expressions that an ave an important ith, and deflection uction are not. In ave some influence cumstances. Very	group c-tiz the forma d soi d are t is Muc re de influ n are In no	es that are termed red wheels are repre- maximum pull developed ance. The data are il strangth on wheel idiameter, width, shown that wheel perch of this variation erived. In both soil mence on performance, every influential confrictional soils it read pattern cantle benefit is de-
inefficient. KEYWORDS: Dimensional analysis; Mobili Pneumatic tires; Rigid wheel			

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The survey reported herel. Was a and serial photographs that would be used attributes of the environment found. These physical attributes include surfacementy, and climate. Sections corresponded section were established for fit to their data content. Each section was text and map references. A list of 1613 unclassified reference were evaluated according to the data, (b) qualitative data, (c) useful etc., and (e) not reviewed. Of these reference were cross-filed, and 117 were not pared to show specific areas of Thailand these areas were less than the entire confied by a series of symbols indicating cection (text, maps, or both), (c) evaluated. KEYWORDS: Bibliographies: Environmental	eful in quantitic in Thailand the geometry, so pronding to the ling and cross-s further subdivences was compile following can data absent, (deferences, 1012 reviewed. Geog described in ountry, Each be (a) section and unation category	tatively hat affectils, verifiling ivided i led, an ategorie i gazet traphic the ann oibliograph of reference, and (describing the physicat ground mobility. Egetation, hydrological attributes and a references according anto two subsections, and the contents of each as: (a) quantitative teers, bibliographies, review d and unnotated, index maps were presonated references when applied entry is identificated number, (b) subdir and where cross-
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dry sand. Horizontal and vertical for The test variables included tire width on the tire. The soil strength was va mensional analysis of the tire-soil sy	ces, torque, slip, and diameter, tire ried over the full stems tested yields	and sinkage were meas e deflection, and the practicable range. A ed four principal inde	sured load A di- epen-
dent Pi terms: the shape number $\frac{b}{d}$, number $\frac{Cd^2}{u}$, and the sand loading num	the deflection number $\frac{Gd^3}{u}$. Four definition	ber $\frac{\sigma}{h}$, the $::$ lay load ependent Pi termsthe	ling a
pull number $\frac{P}{V}$, the sinkage number $\frac{z}{J}$			
force number $\frac{PT}{W}$ were used as measur	es of tire performa	ance. The experimenta	11
results showed, both for the clay and could be evaluated, and that true scal was developed for each of the soils the and this term was shown to be related ating the following relations were developed.	ed systems could be at combined all of to the dependent pa	e achieved. A single the independent param arameters. Curves del	term neter
$\frac{P}{W}$, $\frac{z}{d}$, $\frac{Q}{dW}$, $\frac{P}{W} = \sqrt{\frac{Cbd}{W}(\frac{6}{h})^{1/2}}$ for c	$lay; \frac{P}{W}, \frac{z}{d}, \frac{Q}{dW}, \frac{F}{W}$	$\frac{P_T}{W} = f \left[\frac{G(bd)^{3/2}}{W} \frac{\delta}{h} \right]$ for	
KEYWORDS: Dimensional analysis; Labora predictions; Pneumatic tires	itory tests; Mobilit ;; Soil-wheel intera	ly numbers; Performance action; Tire performanc	: :e;

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13- ABSTRACT						
This report presents the results of te	hatauhaan ataa	es dota	ina tha canahilitics			
of active electromagnetic sensors open						
region to measure terrain characterist						
Controlled tests were conducted under						
correlate the effects of soil composit						
the quantity of infrared energy reflect						
tests indicate that the composition ar						
speciness can be characterized by active infrared sensors under controlled laboraterized						

oratory conditions. However, since infrared energy is reflected by infinitesimally thin surfaces of materials, information concerning density and subsurface parameters cannot be discerned. Techniques for prediction of soil parameters through the use of multiwavelength analysis are discussed.

KEYWORDS: Infrared rays; Laboratory tests; Remote sensing; Soils; Trafficability

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13 ABSTRACT Laboratory tests were conducted	ed with radar s	ensors (o detect the process	
of and measure the depth to subsurface	interlaces wn	en the s	Milace was pare, and	
to determine the influence of vegetati	on at various	stages c	or growen on radar	
responses. A secondary purpose was to	continue eari	ier stud	iles to relate ladar	
returns and the electrical constants t	that they provi	aca to a	moisture content and	
density of samples. Large laboratory	samples were p	repared	at various moisture	
contents and densities and with variou	is depins to a	subsuri	ice metal place.	
Standard pulsed radar sensors operation	ng with frequen	cies of	297, 5070, 9375, and	
31,543 mcgacycles/sec and directed at	various angles	of inci	idence to the surface	
were employed. The results of this la	aboratory study	indicat	te that the standard	
pulsed radar sensors can provide infor	mation that wi	ll permi	it an estimate of the	
moisture content of deep, homogeneous	soil samples a	nd the d	detection of surface	
vegetation of various heights. Radar				
more significantly altered at Ka-, X-	. and C-bond fr	equencie	es then et P-band	
frequencies. However, standard pulsed radar sensors used monochromatically cannot				
provide information for predicting depth to subsurface interfaces or for directly				
indicating the presence of a subsurface interface. The systematic manner in Which				
soil dept, were varied in this study permitted an analytical solution to the				
problem of measuring depths of layers and led to the conclusion that properly				
declared radar systems could measure depths to subsurface interfaces. Three and				
systems are proposed.				
KEYWCRDS: Laboratory tests; Radar; Res	mote sensing; S	oils; Tr	afficability	
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Gamma-ray spectra over the energy ran	ge 0 to 2.82	mev were	obtained from samples		
of sand, silt, and clay. All tests were c designed low-background enclosure. Data w	onducted in the	the labora	tory in a specially		
energy level and radioactive source conten	t in relation	n to soil	parameters.		
The results indicate that the thorium		-	•		
are proportional to moisture content expre	ssed as a per	rcentage o	f dry soil weight.		
When expressed as ratios to one another, t	he photopeaks	lose nea	rly all moisture con-		
tent information but appear to be related types.	to each of the	ne three s	elected specific soil		
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Appendixes A and B present a listing cussion of the data reduction techniques t	or the FUKIKA hat it uses t	in the ana	r program and a dis-		
cussion of the data reduction techniques that it uses in the analysis of gamma-ray spectral data.					
KEYWORDS: Gamma rays; Laboratory tests; Remote sensing; Soils; Trafficability					
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TERRAIN ANALYSIS BY ELECTROMAGNETIC MEANS: REPORT 4; LABORATORY INVESTIGATIONS OF THE INFRARED EMISSIVITY OF SOILS BELOW A WAVELENGTH OF 7.7 MICRONS

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U. S. Army Materiel Command Washington, D. C. 20315

This report presents the results of tests using a passive infrared scanning system responsive to radiation below approximately 7.7 microns to determine if a correlation could be found between the infrared emissivity of soils and their trafficability parameters. It was established that a relation between the passive emission of soils and soil surface moisture content can be measured. but contributing factors other than soil emissivity were encountered. These factors were soil surface temperature and incident radiation on the soil surface. These factors so influenced the magnitude of the net detected energy that this measurement is meaningless, in terms of soil emissivity, unless the contribution of the other factors is known. Progressive modifications in measuring techniques were made in an attempt to isolate these components. The data indicate that the information that can be obtained from a passive infrared sensor using the technique derived herein is not sufficient to determine emissivity values of terrain with sufficient accuracy for practical application.

KEYWORDS: Infrared rays; Laboratory tests; Remote sensing; Soils; Trafficability

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This investigation was made to (a) measure the basic electrical properties of various test samples at frequencies ranging from 1.074 to 1.499 GHz with an L-band interferometer and (b) to relate these basic electrical properties to the physical properties of the test samples. Twelve soils, described in Appendix A, were used in the test program. Laboratory tests on soil samples at various moisture contents and densities indicate a strong, nearly linear relation between the volumetric water content and relative dielectric constant. This relation is not greatly affected by changes in soil density, soil type, or small changes in frequency. Similar relations also exist between loss tangent and electrical conductivity and volumetric water content as modified by frequency, and may be useful for soil type identification. Tests were also run on samples of water and a sample of concrete. Results from the water samples show a decrease in the relative dielectric constant, loss tangent, and electrical conductivity with increasing temperature. The decrease in relative dielectric constant appears to be uniform with temperature from 0 to 65 C and is slightly less than 1/2 percent/C. This ratio may prove useful in estimating the effects of temperature change on the electrical properties of a soil-water mixture. Dielectric constant measurements are shown to be a sensitive measure of water loss in a concrete sample. In addition to the L-band interferometer, two other dielectric constant measurement devices are described in Appendixes B and C and the results of tests with these devices are presented. These are (a) a capacitor measuring system operating between 1 and 75 MHz for soil and water samples and (b) an open wire line (OWL) probe operating between 1 and 2 GHz for soil and concrete samples. KEYWORDS: Concrete samples; Laboratory tests; Microwaves: Remote sensing: Soils: Trafficability

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CHARACTERISTICS OF U.S. RICE FIELDS AN	ND THEIR EFFECT	S ON GRO	OUND MOBILITY
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13 ABSTRACT	-		
The primary objective of this study was mental characteristics of rice fields these characteristics on ground mobiliteristics of rice fields in Southeast located in rice fields in a variety of practices in Arkansas and Louisiana. be visited for data collection several collected were soil moisture, soil str	in the United aty for comparist Asia. Twenty-is soil types and Fifteen of the times during a	States a son with two stud d under se sites a one-ye	and the effect of a similar charac- ly sites were various cultural swere scleeted to ear period. Data

The primary objective of this study was to obtain information on the environmental characteristics of rice fields in the United States and the effect of these characteristics on ground mobility for comparison with similar characteristics of rice fields in Southeast Asia. Twenty-two study sites were located in rice fields in a variety of soil types and under various cultural practices in Arkansas and Louisiana. Fifteen of these sites were selected to be visited for data collection several times during a one-year period. Data collected were soil moisture, soil strength, vegetation characteristics, surface geometry, hydrologic geometry, cultural practices, and weather. General conclusions were: (a) for most sites a good correlation exists between soil strength and soil-moisture content; (b) estimates of soil strength can be made by employing the WES soil moisture-strength prediction method; (c) surface geometry features of U. S. rice fields would not be a significant deterrent to ground vehicles; (d) the soil strength in the fields tested is adequate to support at least one pass of most military vehicles; and (e) most hydrologic geometry features in U. S. and Southeast Asian rice fields are insurmountable for present standard military vehicles.

KEYWORDS: Environmental analysis; Environmental factors; Rice fields; Temperate regions; Terrain analogs; Trafficability; Tropical regions; [Thailand, M.s. Rocer Plants plants]

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Smith, J. L.		
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soil conditions on the performance of	sel to determine the t	effects or Wet survace
were of three types: (a) unflooded, ()	b) flooded and undrain	ned, and (c) flooded
and drained. Tests were conducted on a	fat clay and silt. Al	ll test tires were
6.00-16, 4-PR. Four tire surfaces, or	tread patterns, were	tested: a smooth tire
(i.e. no tread), a directional tread, a	a nondirectional tread	d. and a smooth tire
w'th traction aid.		•
It was found that for a given wheel los	ad the loss of pull (used to express per-
formance) due to flooding was essential	lly constant for each	tread pattern. The
treaded tires and the smooth tire with	traction aid performe	ed better than the
smooth tire in flooded soil, but there	was no significant di	ifference between the
tread patterns other than smooth. In t	the unflooded soil, th	he tread pattern made
a considerable difference in performance	ce. Peak performance	usually was attained
at an optimum load, regardless of tread unchanged through five passes in the un	d pattern or soll conc	lition. Pull remained
unchanged through five passes in the un the flooded-and-drained soil, and decre		
undrained soil. Hagnitude of pull was		
flooding. Lowest pulls due to slipper	iness were attained wh	men the flooding period
was very brief and the soil strength hi	igh.	
KEYWOWS: Fine-grained soils: Flooded a	- distribunghang bank	- • • • • • • • • • • • • • • • • • • •
KEYWOwS: Fine-grained soils; Flooded soil-wheel interaction; Traff	ficability	s; Pneumatic tires;

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Terrain factors that significatly affect the encompassed in four factor families—surface and hydrologic geometry. Since a condition of terrain on vehicle locomotion in Southeas for detailed study. These areas are in the Mai, Pran Buri, Khon Kaen, and Chanthaburi. This volume is a summary and discusses in geto acquire the necessary quantitative terral employed to adapt these data to displays the country locomotion analysis. Data collective chniques for mapping the specific factors Volume II (Surface Composition), Volume III and Volume V (Hydrologic Geometry). Data appropriate volumes. Air-photo interpretat patterns of terrain features are presented the factor-family maps into factor-complex volume VII. Map sets for each of the four presented in Volume VIII.	e composition of this student Asia, six vicinities This reporteneral terms in informaticat meet the con, reduction of each fact (Surface Genumaries are ion techniquin Volume VI maps for mobile of the control of the c	on, surface ady was to a careas in hof Nakhon Set is present the proced on and the specific remains and analystor family cometry), Vote included a less used to C. The methodility purposed and the specific remains the surface of the set of the	geometry, vegetation, establish the effects Thailand were selected Sawan, lop Buri, Chiang nted in eight volumes. dures that were used techniques that were equirements of crossysis procedures, and are presented in olume IV (Vegetation), as appendixes to the identify air-photo hod used to synthesize oses is presented in
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This volume presents the methods used to co			
surface composition of six selected Thailar Chiang Mai, Pran Buri, Khon Kaen, and Chant			
pressed the different soil mass strength a			
established. The criteria used in isolating	ne these cla	stet AGLG	(a) that each class be
identifiable using air-photo interpretation			
similar variations in strength with moistur			
cability characteristics in terms of the 1			
composition maps together covering the six	study areas.	. This del	lineation was accom-
plished through interpretation of maps and	air photos v	with contro	ol data in the form of
field and laboratory information. The maps	s are present	ted in Vol	ume VIII of this re-
port. A compromise between the desired de	gree of mapp:	ing class	refinement and that
aictated by the photo-interpretation criter	ria was neces	ssary beca	use of the nature of
the field data. During the mapping program unsampled areas, the degree of mapping refi	n when sompte	e site data	a were extrapolated to
It is recommended that additional studies h	he conducted	on the us	cy only rain to tow.
identification techniques in classifying so	oil strength	condition	e. This approach is
believed to be basically sound; nowever, mo	ore field ver	rification	of predicted values
will help to determine the reliability of t	this approach	n.	** ************************************
KEYWORDS: Airphoto interpretation; Mobility	•		factors: Surface
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This volume presents the methods used to c					
on the surface geometry of selected areas	in Thailand.	The desc	criptions of surface		
decometry features are so designed that the					
as input to an analytical model for predic					
military vehicles. A method for classifyi					
geometry factors from serial photographs (
field data collected and the air-photo int					
geometry factor-family maps were prepared,					
areas (Nakhon Sawan, Lop Buri, Chiang Mai,					
These mpas are presented in Volume VIII of					
methods for predicting and mapping curface	geometry fa	ctors ver	regely successful.		
However, the degree of accuracy achieved for each of these factors varied con-					

KEYWORDS: Airphoto interpretation; Mobility; Surface geometry factors; Surface geometry mapping: Terrain analysis; Tropical regions; [Thailand]

siderably, being a function of the scale, quality, and vintage of the existing photography. It is recommended that studies be continued to develop air-photo interpretation techniques to improve the reliability of estimation of surface geom-

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Vegetation characteristics were measured according to established sampling procedures at 295 sites within six areas of Thailand. From these samples, stem diameter and spacing data were extracted for analysis, since these are the factors that significantly affect performance of ground-contact vehicles. A dual classification system was devised for mapping these factors in which spacing values of 0-1.5 m, >1.5-3.0 m, >3.0-9.0 m, and >9.0 m were determined for stem diameters of 5 cm or less, 13 cm or less, 23 cm or less, and 130 cm or less, and stem diameters of 3 cm or more, 8 cm or more, 15 cm or more, and 25 cm or more. Map units were identified and delimited on aerial photographs by established photo-interpretation keys and techniques. Twenty-five 1:50,000-scale map sheets were prepared for the six study areas, on which 72 distinct mapping classes were identified. The vegetation field data for the six study areas are summarized in Appendix A.

KEYWORDS: Airphoto interpretation; Mobility; Terrain analysis; Tropical regions; Vegetation factors; Vegetation mapping; [Thailand]

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IS. ABSTRACT			
This volume presents the methods used in conselected areas in Thailand. The selection			
eters significant to vehicle mobility are	iiscussed.	The photo-	interpretation
methods used in identifying hydrologic geometric	metry feature	es from me	rial photographs
(air photos) and the extrapolation of these	identifica	tions to a	reas not investi-
gated on the ground are presented. The rat these parameters is explained. Utilizing t	the collecter	cartograpo A field de	te portrayal of
photos, and the Army Map Service series of	topographic	maps, hyd	rologic geometry
factor maps were prepared covering the six	selected st	udy areas	(siakhon Savan,
7 p Buri, Chisag Mai, Chanthaburi, Pran Bu	ri, and Khon	Kaen). T	he maps are pre-
sented in Volume VIII of this series. It mine the existence and value of the chosen	proved only	partially	possible to deter-
of the individual factors are wholly or par			
theless, photo interpretation plus extrapol	lation from :	measured s	ites made it
possible to map the parametric values by c	lass range v	ith reason	able validity.
Recommendations are made involving improves	ment in data	-collectio	n techniques.

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KEYWORDS: Airphoto interpretation; Hydrologic geometry factors; Hydrologic geometry mapping; Mobility; Terrain analysis; Tropical regions; [Thailand]

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This volume contains a catalog of phot	ogranhe of The	11and +	annels Contumes
described in such a way that the infor	mation can be t	need in	making astima.
tions of their effects on the performs	ace of ground	vehicle	. Results of
a limited study of the effects of film	emulsion on th	he acqu	isition of
terrain information from aerial photog	raphs are also	present	ed.
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KEYWORDS: Aerial photographs; Airphoto	interpretation	n; Mobil	lity; Terrain analysis;
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Advanced Research Projects Agency
Service Agency: U. S. Army Materiel
Command, Washington, D.C.

Individual factor maps, devised as a product of the processes described in Volumes II, III IV, and V of this report, were compiled into a set of factorfamily maps (surface composition, surface geometry, vegetation, and hydrologic geometry) by a process of sequential superpositioning. The factor-family maps were then compiled into two kinds of "factor-complex" maps: areal factor-complex maps, which display the areal extent of discrete combinations of factors value classes of three factor families (namely surface geometry, surface composition, and vegetation); and linear factor-complex maps, which display the occurrences of linear features (i.e., streams, canals, lakeshores, etc.) and the surface composition and vegetation immediately associated with them. Each discrete factor complex, whether areal or linear consists of a unique combination of factor value classes. Since the factors and factor value classes were chosen because of their significance to vehicle locomotion, it is presumed that each factor complex will affect vehicle performance in a specific and identifiable way. Because the data defining the factor complexes are pracisely those required as terrain input values for the vehicle performance prediction model, the factor-complex maps furnish a comprehensive and concise data store for estimating the cross-country speeds of many military vehicles operating in terrains such as those of Thailand.

KEYWORDS: Mobility; Terrain analysis; Terrain factor maps; Terrain factors; Terrain mapping; Tropical regions; [Thailand]

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KEYWORDS: Groundwater; Laboratory tests; Radar; Remote sensing; Soil moisture prediction; Soils; Surface water; Trafficability

such sensors do not permit prediction of depth of surface water, presence of ground water, or depth to ground water. Systematic variation of surface-water depths and depths to ground water permitted an analytical solution for measuring surface- or ground-water depths, and led to the conclusion that properly designed radar systems could measure surface- and ground-water depths. Three

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MECHANICS OF WHEELS ON SOFT SOILS; EFFECT	OF WIDTH ON RICID WHE	PT. DEPENDMANCE
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Tests were run in an air-dried sand using three rigid wheels 28 in. in diameter and 12, 6, and 3 in. wide to determine the effect of wheel width on performance. Performance in this study was evaluated in terms of pull, torque, and dissipated energy. It was found that the width/diameter ratio influenced the rate of increase of torque energy at low slips, but at high slips, the slopes of the dissipated energy lines were approximately the same for all rigid wheels. An increase in load at a given high slip caused some changes in torque energy, and there was a load for which the torque energy was a minimum. The dissipated energy tended to increase with an increase in load, so the pull energy tended to decrease with an increase in load. Energy parameters measured in these tests with rigid wheels were compared with similar parameters from tests with pneumatic tires. In all cases, the preumatic tire was found to be more efficient, with the better performance attributed mostly to a lower energy dissipation.

KEYWORDS: Laboratory tests; Pneumatic tires; Rigid wheels; Sands; Soil-wheel interaction; Trafficability; Wheel width

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11. SUPPLEMENTAR (NOTES

U. S. Army Materiel Command Washington, D. C. 20315 13 ABSTRACT Field and laboratory tests were conducted on 11 fine-grained soils from the

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U. S. Army Materiel Command Washington, D. C. 20315

temperate climate of the United States and 17 fine-grained soils from the tropical climates of Puerto Rico, Panama Canal Zone, Hawaii, and Thailand to determine the trafficability and other engineering properties of the soils. Soils were collected from the 6- to 12-in. Layer for a wide range on parent materials. Temperate and tropical soils of each parent material were selected on the basis of their similarity in the Unified Soil Classification System and in topographic position. A comparison of physical, mineralogical, and chemical properties, and results of standard and special engineering tests indicate, with few exceptions, no significant differences between temperate and tropical soils from a similar parent material. It is concluded that temperate and tropical soils of similar parent material and Atterberg limits generally have other engineering properties

that are similar and behave similarly when subjected to standard and special engineering laboratory tests. Differences in behavior between soils from each of the climates can be associated with differences in Atterberg limits.

KEYWORDS: Field tests; Laboratory tests; Parent materials (Soils); Soil property relations; Soil property variations; Temperate regions; Trafficability; Tropical regions; [Hawaii; Panama Canal Zone; Puerto Rico; Thailand; United

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13. ABSTRACT					
A program of trafficability tests was					
Wainwright, Aleske, with four tracked an M59 armored personnel carrier, an M					
Self-propelled, go-no go tests were con					
drawbar-pull tests were conducted with					
country speed tests were conducted wit	h the Mll6 and	M59 R	esults indicate that		
a combination of depth to permafrost a					
frost affects vehicle performance on a					
pull of the M116 was 59% of its gross					
torque converter output. The maximum					
40% of their gross weights and were li					
In the cross-country tests, the speed inability of the driver to see over th					
speed of both the Mll6 and the M59 when traveling on muskeg, as compared with maximum speed on hard surfaces, may be attributed to increased motion resistance.					
Depth to permafrost was affected by surface cover; the shallowest permafrost was					
. found generally under dense, woody vegetation, and the deepest permafrost was					
found generally in areas covered with grass and water or where all vegetation had					
been removed.					
KEYWORDŞ: Field tests; Military bases;					
Trafficability; [Fort Wainwright, Alaska; M41; M59; M60A1; M116]					
					
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TRAFFICABILITY CLASSIFICATION OF THAIR	AND SOILS				
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Pertinent soil trafficability data were collected during the wet season at 846 sites in Thailand. The soils were identified according to the Unified Soil Classification System and the U. S. Department of Agriculture textural classification system. Two general topographic positions (high topography and low topography) and two general levels of wetness were considered. A scheme for classifying soils according to their trafficability was developed. The scheme lists the soil types in order of decreasing trafficability under each of three topography-wetness level categories and shows the probability of successful passage on each soil for vehicles of known soil strength requirements. The scheme permits the estimation of the probability of a successful operation for given soil type, topography, and wetness-level conditions. If a choice of several routes and vehicles is available, the determination of the vehicles with the best chances of success over a given route or of the best route for given vehicles can be made.					
KEYWORDS: Soil properties; Statistical Trafficability data; Tropica	. analysis; Trai l regions;[Thai	ficabil:	ity classification;		

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AN ANALTYICAL MODEL FOR PREDICTING CROSS-O APPENDIX A: INSTRUMENTATION OF TEST VEHICL		LE PERFORM	ANCE:	
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An instrumentation system was developed to of a moving vehicle to discrete environment override vegetation, drive-line torque, vehicles and the displacement, fuel consumption, acceleration made to determine the effects imposed on the lateral, and vertical obstacles. The spectarious measurements are described and infooperation is presented.	tal factors. hicle linear on, pitch, ar he vehicle by ific componer	Measureme and wheel ad hydroste soil and ats of the	nts of force to or track rotational tic pressure were longitudinal, system used for the	
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A total of 95 lateral obstacle tests were conducted with two tracked and three wheeled vehicles at the NASA Marshall Space Flight Center, Miss., and Eglin Air Force Base, Fla. The principal conclusions from these tests were that (a) vehicle performance in terms of speed made good in an array of vegetation assemblages can be correlated with the density of vegetation assemblages expressed as mean obstacle spacing, (b) the minimum obstacle spacing required to permit movement of a vehicle can be computed from vehicle width, and (c) the speed made good a vehicle can achieve when maneuvering in lateral obstacles is significantly affected by the slope of the terrain. Methods of determining mean obstacle spacing from structural cell diameter and percent area denied from stem diameters of trees, vehicle width, and structural cell diameter are shown. A method of determining percent area denied by logs, mounds, and other obstacles is suggested.

KEYWORDS: Field tests; Military vehicles; Mobility; Mobility models; Performance tests (Vehicles); Vegetation factors; [Eglin AFB, Fla.; Marshall Space Flight Center, Miss.]

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Unclassified Security Classification DOCUMENT CONTROL DATA - R & D (Security classification of title, body of abattact and indexing annotation must be entered when the everals report is classified) ORIGINATING ACTIVITY (Corporate author) 20. BEPORT SECURITY CLASSIFICATION 'inclassified U. S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi AN ANALYTICAL MODEL FOR PREDICTING CROSS-COUNTRY VEHICLE PERFORMANCE; APPENDIX B: VEHICLE PERFORMANCE IN LATERAL AND LONGITUDINAL OBSTACLÉS (VEGETATION): VOLUME II: LONGITUDINAL OBSTACLES 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Appendix B, Volume II, to final report Claude A. Blackmon Donald D. Randolph TA LOTAL NO. OF PASES Th. MO. OF REEL July 1968 ORIGINATOR'S REPORT NUMBER(S) Technical Report No. 3-783 ARPA Order No. 400 Appendix B, Volume II 1-V-025001-A-131 10. OTHER REPORT HO(S) (Any other numbers that may be explained AD 838 872 10. DISTRIBUTION STATEMENT Approved for Public Release; Distribution Unlimited 11. SUPPLEMENTARY MOTES 2. SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency and Development Directorate, U. S. Army Materiel Command A total of 372 tests were conducted with one tracked and one whee'ed vehicle at the NASA Marshall Space Flight Center, Miss., Eglin Air Force Base, Fla., Pren Buri, Thailand, and Khon Kaen, Thailand. The general purpose of these test was to obtain data relating characteristics of longitudinal obstacles to vehicle performance in terms suitable for use in developing that portion of the analytical model for crosscountry performance. The specific purposes were (a) to determine the maximum horizontal force and total work required to override single standing trees of a range of sizes at various speeds and pushbar heights and (b) to determine average horizontal force and total work required to override trees in multiple array. Empirical relations are presented to support the conclusions that pushbar force required to fail trees singly and in mulitple array, work requires to fail trees singly and in multiple array, and work required to override a single standing tree may be predicted from stem diameter(s). A method is suggested for predicting work required to override trees in multiple array. The results of the tree-felling tests in the Tunguska meteorite area were confirmed, with a single exception noted, and discussed. It is recommended that edditional testing be done in areas of soft soil to determine the effect of soil strength on uprooting, and in grass and brush areas to determine the effects of small vegetation on speed. KEYWORDS: Field tests; Mathematical models; Military vehicles; Mobility; Mobility models; Performance tests (Vehicles); Tropical regions; Vegetation factors;

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This appendix presents a brief history of vehicle dynamics modeling, a recapitulation of the U.S. "my Engineer Waterways Experiment Station approach to the problem of predicting enicle performance in terrain containing discrete vertical obstacles, and descriptions of dynamic response prediction models for the M60Al tank and M37 truck, and compares measured and predicted venicle performance in terms of peak vertical and longitudinal accelerations for 78 rigid obstacle tests with the two vehicles. Major conclusions from the tests were that performances of the M60Al tank and M37 truck in terms of peak vertical and peak longitudinal accelerations experienced at the driver's seat when traversing discrete, rigid obstacles can be correlated with impact speed, that the mathematical techniques described yield reasonably accurate predictions of the spee' at which the MEGAL tank can contact a rigid obstacle without exceeding specifier tolerance limits, and that refinement is needed in the dynamic response prediction model for the M37 truck.

Field tests; Military vehicles; Mobility; Mobility models; Performance tests (Vehicles); Surface geometry

factors; Tanks (Combat vehicles); Trucks; [M37 truck; M60Al tank

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to support th	ne conclusions that performance	of amphibi	ous tracke	d and wheeled vehicles	
(in terms of	"go-no go") in the water-land	interface of	an be corr	elated with soil	
strength (exp	pressed as average cone index of	of the O- to	6-in. soi	l layer), and that the	
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AN ANALYTICAL MODEL FOR PREDICTING CROSS-	COUNTRY VEHI	CLE PERFORM	MANCE: APPENDIX E:
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A total of 39 tests were conducted with t	wo wheeled aw	nd two wrea	ked vehicles at three
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tablish procedures for quantifying screen			
and to relate recognition distance to max			
defined in this study as that distance wh	erein 76 per	cent of the	dots painted on a
standard target could be counted in a veg	getation assa	mblage, Pr	redictions of maximum
safe speeds were computed based on recogn	nition distan	ce, and ave	rage deviation of
predicted maximum safe speed from actual	average spee	d for each	test was 3.3 mph on
the safe side. It is recommended that ad	lditional tes	ting be don	ne to develop a less
tedious and time-consuming procedure for	determining	recognition	distance in vegetated
areas and that stopping distance-soil str	rength relati	ons be esta	iblished,
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APPENDIX F: SOIL-VEHICLE RELATIONS ON SOFT	CLAY SOILS	(SURFACE C	COMPOSITION)	
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Sixty-six acceleration-deceleration tests	were conducto	ed with the	ree wheeled and two	
tracked vehicles at five sites in Thailand	. The princ	ipal conclu	sion from these tests	
was that vehicle deceleration in soft clay				
expressed as the average 0- to 6-in. cone	index. The	analysis in	ndicated that accelera-	
tion increased with an increase in soil st	rength, but	no definiti	ive correlation could	
he established Semiempirical and empirical	al relations	were used	in a first-generation	

analytical model to predict average speed over the test courses. Comparisons of measured and predicted speeds led to recommendations for specific additional studies to improve the reliability of the WES analytical model.

KEYWORDS: Field tests; Military vehicles; Mobility; Mobility models; Performance tests (Vehicles); Soil strength; Surface composition factors; Trafficability; Tropical regions;

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The XM759 was tested at sites in Virginia and Louisiana on a wide range of terrain conditions analogous to those of the Mekong Delta, South Vietnam. The off-road performance of the XM759 was compared with that of an Mil6, 1-1/2-ton Cargo Carrier, Amphibious, on the same test sites. An evaluation of the comparative performances of the XM759 and Mil6 in terms of terrain-vehicle relations (trafficability tests) and average speed for the terrain types tested (mobility tests) shows that the XM759 outperformed the Mil6 for most of the terrain conditions tested. Appendix A shows the computations necessary for determining VCI's of tracked vehicles. Appendix B presents a method for determining the effects of buoyancy on VCI's. Appendix C presents results of the terrain evaluation study to identify terrain types in several sections of South Vietnam and to locate similar areas in the Mississippi River Delta for vehicle test purposes.					
KFYWORDS:	Amphibious vehicles; Cargo vehic Terrain analogs; Terrain analysic cargo carrier; Mekong Delta; Miss	s; Trafficab	llity; Trop	ical regions;[Ml16	

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Pneumatic tires; Ride dynamics

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Wiener-Bose Theory is a strategy for identifying nonlinear systems in terms of a set of "characterizing coefficients." A computer study was conducted to discern problems of implementation of the theory. Several systems of increasing complexity were studied and a practical form of Wiener-Bose Theory evolved. The systems studied were as follows: (a) a zero-memory system, (b) rate-independent hysteresis, (c) a second-order system with saturation, and (d) a fourth-order mechanical system with nonlinear compliances. A military M37, 3/4-ton truck was selected for characterization using a Wiener-Bose model having 1024 coefficients. The characterizing coefficients were obtained by utilizing the responses of the vehicle recorded during traversal of a specially configured obstacle course whose total length was 2.5 miles. Once the coefficients were obtained, they were used to synthesize responses to specific terrain profiles. These predicted responses compared favorably with counterpart responses of the vehicle traversing the same profiles. It was concluded that Wiener-Bose Theory is capable of satisfactory performance in the analysis of many nonlinear systems. The principal difficulty in its practical application is the extensive probing effort required for characterizing the system.

KEYWORDS: Mathematical models; Mobility; Mobility numbers: Nonlinear systems; Ride dynamics; Trucks

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U. S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi

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DYNAMICS OF WHEELED VEHICLES; Report 3, A STATISTICAL ANALYSIS OF TERRAIN-VEHICLE-SPEED SYSTEMS

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to Mississippi State University, State College, Mississippi as thesis for degree of Master of Science in Engineering

U. S. Army Materiel Command Washington, D. C.

Digital computer simulations were conducted in which a vehicle was run at several selected speeds over terrain profiles with various levels of roughness. The terrain profiles were generated by computer programs that constructed and shaped sequences of random normal numbers to provide representative profiles with a desired power spectrum, variance, mean value, standard deviation, and RMS. These programs also performed the necessary statistical checks for normality, stationarity, and randomness. A comprehensive, nonlinear mathematical model of an M37 truck served as the vehicle. This model allowed for the nonlinearities inherent in large rotational motions, the suspension eleements, bump stop, loss of ground contact, and the tire compliance, which was represented by a cluster of radially projecting springs. The results are presented in the form of three basic graphs comparing input and output statistics and distribution functions. The input statistics consisted of terrain roughness as measured by RMS elevation. The output is represented as the RMS vertical acceleration of the vehicle's center of gravity. A family of curves was developed relating vehicle response to terrain roughness for each speed of vehicle traversal. Cross plots of these established relations provided a more useful relation between vehicle response and speed for various degrees of terrain roughness.

KEYWORDS: Computerized models; Mobility; Mobility models; Ride dynamics; Statistical analysis; Trucks; Vehicle speed; [M37 truck]

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18 ABSTRACT					
Approximately 300 tests were conducted wit					
	and shapes. Data for acceleration-time his-				
tory, vehicle speed and pitch angle, and e tape, which was processed by an analog com					
lowing parameters were determined (at the					
(a) peak, root me in square, and mean root	mean square values of vertical acceleration,				
and the vector sum of vertical and longitu	dinal acceleration components; and (b) ve-				
hicle impact speed and average speed durin	g obstacle traversal. Linear correlations				
or venture average speed with peak and sta	tistical accelerations were determined by ng coefficients of determination, the sta-				
tistical values were found to exhibit a mu	ing coefficients of determination, the sta- ich higher degree of correlation with vehicle				
	series of constant-condition tests revealed				
that the statistical descriptors of vehicle response were superior to peak values in					
terms of repeatability strategy was devised for displaying test results in compact					
graphic form, which is useful for predicting vibration severity caused by traversal of					
single obstacles and can be included easily in comprehensive models of vehicle mobil- ity. Statistical and peak acceleration values were compared with corresponding values					
obtained from an analytical simulation of	the M37 truck to determine whether static-				
obtained from an analytical simulation of the M37 truck to determine whether statis- tical descriptors can be used to validate analytical models. Further model testing					
will be required before conclusions can be	drawn.				
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An analysis of experimentally determined revealed a strong tendency for the norms than-average life rigidity, i.e. along this rigidity is augmented by time sidew question are as to whether the observed directly controlling the time rigidity is distribution, with the net result of imp	al stresses to the periphery of wall stillness and phenomenon opattern, and the	by greater of the cont and/or inc could be us us favorab	in areas of higher- act patch where the al tire flexing. The ed advantageously by ly incluence stress	

An analysis of experimentally determined stress distributions becath tires on sand revealed a strong tendency for the normal stresses to be greater in areas of higher-than-average tire rigidity, i.e. along the periphery of the contact patch where the tire rigidit? Is augmented by tire sidewall stillness and/or local tire flexing. The question are so as to whether the observed phenomenon would be used advantageously by directly controlling the tire rigidity pattern, and thus favorably incluence stress distribution, with the net result of improved tire performance. An experimental wheel was built to test this principle; its performance is described in this report. The control of local tire rigidity we achieved by a system of the nonrotating hydraulic jacks inside the wheel acting against a fixed flexible shoe, along which the inner surface of the tire slid as it rotated. Tests with sand at two corrects hevels showed that the whiel with favorable rigidity distribution (increasing rigidity to the rear of the scill-wheel interface) developed up to ? percent more pull than the wheel with unfavorable rigidity distribution. The greater pull was paralleled by an efficiency increase of the same order. These experimental results are explained by theoretical computations based on the variation of assumed stress distribution as a function of the rigidity pattern. The experimental wheel was built to check a principle rather than to be used as a means of locomotion, but the prospect of applying the principle of controlled rigidity in practice is shown to be promising.

KEYWORDS: Pneumatic tires; Sands; Stress distribution; Stresses under wheels

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13 ADSTRACT					
The results of plate-sinkage tests for normal loads	and correspond	ling load-sin	kage relations for towed		
vehilies are frequently expressed by the simplified		-			
unit load or pressure, z the sinkage, k the sink	•		•		
shown that this equation does not satisfactorily re a plastic clay and in a fine cohesion ess sand per					
pacity of soils are reviewed and used to derive di					
loads, taking size, shape, and depth of the loaded					
these equations are partially substantiated by the	test data, but s	agnificant de	eviations occur, especially		
with increasing depth-diameter ratios of plates in					
indicate that the tangential components of incline					
plate-shear tests may cause failure in bearing capa fore the peak shear strength of the soil in the co					
plates also show that failure along inclined planes					
the full shear strength is attained in horizontal pl					
rences on interpretation of the test data is discus	sad. Recomme:	ndations are	rade for further research		
to determine the influence of size, shape, and de	pth of the load	ed area and	of a load inclination on		
the load-sinkage relations.					
KEYWORDS: Dynamic bearing capacit	v: Plate he	arino te	sts: Pressure-		
KEYWORDS: Dynamic bearing capacity; Plate bearing tests; Pressure sinkage relations; Vehicle sinkage					
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9 1 HOR(2) (First name, middle initiel, last name)						
Dean R. Freitag						
Andrew J. Green						
Klaus-Jurgen Melzer						
- REPORT DATE	74. TOTAL NO. OF PAGES	76. NO. OF REFS				
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Summary of this report is reported in	George C. Marshall					
S. Army Engineer Waterways Experiment		s and Space Administra-				
Station M. P. No. M-70-4	tion, Huntsville, A					
13. AUSTRACT	L					
One pneumatic wheel, four metal-elastic wh	eels, and two instrume	ented vehicles were				
laboratory tested in a fine sand to determ						
establish a better understanding of the basic principles of the interaction of very lightly loaded wheels with a soil whose properties were varied to include the prob-						
able range of lunar soil properties. Prog						
single wheels and the vehicles, the latter						
surfaces. Data indicate that for loads le						
climbing ability was constant for a given						
of increase in performance decreased. The						
ligible at loads less than about 220 N (50						
loads. The results of a with the neta						
relied on to propel a vee up a 35-deg	stope. Modifications	or the Bendix and				
Grunman wheels enhanced their performance						
climb slopes in excess of 30 deg. Tests with modified Boeing-GM wheels indicated that						
they might be used on slopes up to about 25 deg on certain soil conditions. The						
power required, in whr/km, for operation of the wheels on level and sloping soil sur-						
faces was determined. It was demonstrated that data from single-wheel tests can be						
used to predict the slope-climbing ability						
slightly conservative. Results of vests W	ith the vehicles indic	ate that the torque				
coefficient at a given slip was not signif	icantly affected by V	r'ations in surface				
slope and soil strength.						
KEYWORDS: Laboratory tests; Lunar roving ve	hicles; Sands; Soil-wh	eel interaction;				
Trafficability; Wheels		- · · · · · · · · · · · · · · · · · · ·				

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EVALUATION OF WES AVALYTICAL M GAGETY IN, NEW BRUNSWICK, CANAL		s (xm559e1	GOER TESTS AT CAMP
4. DESCRIPTIVE NOTES (Type of report and Inclu	sive daire)		
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Beryl G. Stinson	78. TOTAL NO. O	7	Tit. No. of Mere
March 1970	64		none
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This study was conducted to (a) evaluate the performance of the 8-ton XM559E1 GOER when operating in selected Canadian terrains and (b) evaluate the capability of the WES analytical model to predict the performance of an 8-ton XM559El in selected Canadian terrains. Speed and motion resistance tests on secondary roads, cross-country speed tests, drawbar pull-slip tests, and towed off-road motion resistance tests were conducted. Where pertinent, soil, surface geometry, and vegetation data were collected before or efter each test, and speed, vertical and longitudinal accelerations, percent wheel slip, and drawbar pull were measured. A comparison was made of actual performance and performance as predicted by the analytical model. The average of the absolute deviation, of actual from predicted speeds for the tests conducted was 1.36 mph.

KEYWORDS: Field tests; Goer vehicles; Mathematical models; Military bases; Military vehicles; Mobility; Mobility models; Performance predictions; Performance tests (Vehicles); Terrain factors; [Camp Gagetown, Canada; XM559El Goar]

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2. REPORT TITLE	يسببب فنناتج كساد		
RELATIVE OFF-ROAD MOBILITY PERFORMANCE OF SI SELECTED TERRAIN	IX WHEELED AN	D FOUR TRA	CKED VEHICLES IN
4. DESCRIPTIVE HOTES (Type of report and inclusive dates)			
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March 1970	156		15
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The U. S. Army Engineer Waterways Experiment off-road ground mobility was used to evaluat (M656, h.4A2, K520, M3781, M561, and M706) a and M571) over a selected traverse in Thaila terrain in terms of surface composition (soi rice-field dikes, etc.), vegetation, and hyd performance of each vehicle was evaluated in and the center line, average fuel consumed o delivery rate. The vehicles were "run" over (60 or 40 rating come index) and wet-season Four of the vehicles (M656, M54A2, M520, and conditions of 60 or 40 rating come index. A in an abbreviated form; Appendix B, the evaluated Appendix C, some additional general anal	te the performend four trackind. Maps were a consistency following for the traverse conditions (4 M548) were appendix A dequation of the	mance of some control of the prepared of the p	ix wheeled vehicles es (M548, M113A1, M116 d to exhibit the e geometry (slopes, rs and streams). The d over the traverse center-line cargo y-season conditions ating come undex). o under we'-season e WES analytical model response of the M706:

KEYWORDS: Field tests; Military vehicles; Mobility; Performance predictions; Terrain factors; Tropical regions; [Thailand]

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vehicle performance.

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Vicksburg, Mississippi		SA. SROUP	
PERFORMANCE OF RIVERINE UTILITY CRAFT (RUC) IN RIVERINE	ENVIRONME	ents
4. DESCRIPTIVE HOTES (Type of report and inclusive dates)			
Final report			
6. AUTHOR(6) (Piret mans, middle initial, last name)			
Barton G. Schreiner			
Robert P. Smith			
Charles E. Green		·	·
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	Washington	n, D. C. 3	20360
Tests were conducted at four riviles to evaluate the performance of the Rivamphibian that employs a locomotion concept two counterrotating rotors that give forware to float the craft. The RIC is powered by a payload of 2000 lb; the gross weight of the tests were to (a) develop performance-sterms of maximum straight-line speed, maximute to turn 180 deg, (b) determine water-exit coin a variety of test courses and terrain ty (d) determine the degree of analogof the selected areas of the Mekong Dela, fouth V program were satisfied. Test results indict the riverine environments for which it was effective in water and wet marshes of low scapability in areas considered restrictive phiboious craft. Appendix A discusses the cappersents detailed descriptions of soil professions.	erine sites erine Utility based on the d and backwa two 380-hp en he RUC is 13 oil strength um maneuver apabilities, pes commonly terrain type: ietnam. The ate that, in designed. The oil strength or even inaccomparison of ed areas of	y Craft (Rie Archimederd thrust; ngines and ,000 lh. (rating cospeed, and (c) determ found in stested w specific general, he craft s. The RUC cessible t terrain t the Mekong	ouisiana in November UC). The RUC is an ean screw. It moves by the rotors also serve is designed to carry Specific purposes of one index) relations in minimum time required mine the speed attained wetland marshes, and ith terrain types at purposes of the test the RUC can operate in performance is most also has a performance o boats and other am- ypes tested during the Delta. Appendix B
KEYWORDS: Buoyant screw vehicles;	Field test	ts; Hydro	ologic geometry

factors; Mobility; Performance tests (Vehicles); Stream crossings; Trafficability; [Louisiana; Riverine Utility Craft

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3. REPORT TITLE					
Quantitative Description of Selected West	German Terre	ain for Gro	und Mobility		
4. OESCRIPTIVE NOTES (Type of report and Inclusive dates) Final Report.					
s. AUTHORIS: (First name, aiddie initial, last name)					
H. K. Woods					
J. H. Shamburger					
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			Research Laboratory und Maryland		
This study was performed to classify and map terrain for ground mobility purposes in accessible areas of three German military reservations (Baumholder, Bergen-Hohne, and Grafenwohr). The terrair was classified in terms of surface geometry, surface composition, vegetation, and hydrologic geometry factors that affect vehicle mobility. Mapping of the terrain factors was accomplished through interpretation of air photos. To provide the necessary ground control data for photo-interpretation processes, a field data collection program was conducted, and data were collected according to established procedures. The field data were tabulated and placed in established class ranges significant to ground mobility. Utilizing the field data, an air photo interpretation method was applied to estimate the established terrain factor-value classes from the geometric, tonal, and textural characteristics of the air photo patterns. Terrain characteristics were extrapolated from the sample to the unsampled areas, and factor-family maps at a scale of 1:25,000 were prepared of the three study areas. The factor-family maps were then compiled into areal and linear factor-complex maps. The areal factor-complex maps display the areal extent of discrete combinations of factor-walue classes of surface geometry, surface composition, and vegetation factor families. The linear factor-complex maps display the factor values of linear features (i e. streams, canals, road absultments, etc.) and the surface composition and vegetation associated with them.					
KEYWORDS: Airphoto interpretation; Mobilit Terrain classification; Terrain					

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Terrain factors; Tropical regions

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predictions; Synthalogous environment; Temperate regions; Terrain analysis;

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PEPORT TITLE			
A PRELIMINARY STUDY OF SEAFLOOR TRAF	FICABILITY	AND ITS P	REDICTION
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	U S. Naval Civil Engineering Laboratory		
	Port Hueneme, California		
13 ABSTRACT	<u> </u>	 -	
In anticipation of the growing need for various ty	pes of seafloor	r-crawling ve	hicles, problems of sea-
floor trafficability and of its prediction are outline	d The quali	tative compa	rison between
trafficability-related land and seafloor features show for seafloor-crawling vehicles. Therefore, the soft-	ved that soft-s	on modulity	is the central problem
emphasis within the state-of-the-art review, which	nchides a disc	nesica of ex	visting seefloor.crawling
vehicles The relative merits of the existing basic	running gears	are discusse	d and weighted with re-
spect to different mission profiles and seafloor cha	racteristics, an	d four (whe	el. track. hanming chain.
and sled) selected as prime contenders. A largely	laboratory-con	fined test p	rogram with these four
rinning gears is outlined to respond to the proble	ms of immedia	ete concern.	(a) applicability of
existing land trafficability prediction techniques to	seafioor traffi	calility pred	uction and (b) determina-
tion of go-no go criteria, which, for practical reasons	ons, must be i	related to th	e response of remotely
operated seafloor probing devices. A free-falling to latter purpose.	wo-part cone p	penetrometer	is proposed for this
frantame.			
KEYWORDS: Mobility; Ocean bottom	vehicles	Traffice	bility prediction.
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RELATIVE OFF-ROAD MOBILITY OF MBT70 AND M WEST GERMANY	OOALEI TANKS	IN SELEC	TED TERRAINS IN		
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Adam A. Rula Beryl G. Stinson Claude A. Blackmon Jack K. Stoll					
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	Ballistics Research Laboratories. Aberdeen Proving Ground, Miss and Us S. Army Materiel Command, Washington, D. C.				
IS ABSTRACT	1 1144 1 144	January W			
The speeds of the MBT70 and the M60AlEl tanks over two selected traverses in West Germany were predicted by use of an analytical model. Vehicle performance relations extrapolated from previous field tests with similar vehicles and from terrain data (surface geometry, surface amposition, vegetation, and hydrologic geometry) collected along and adjacent to the selected traverses were used in the analysis. The analytical model is described briefly, and the levelopment of the vehicle-terrain relations necessary to make speed predictions over the traverses selected is discussed in detail. The application of the analytical model, the division of the traverses into discrete sections, the factors affecting speed in each section, and the prediction of the speed for each section are explained. A comparison of the predicted speeds for the two vehicles indicates the MBT70 to have the higher speed. It is suggested that actual field tests be conducted with the vehicles, when practical, to determine the accuracy of the predictions and to improve the quality of the relations used in the analytical model. Appendixes A, B, C, and D describe the determination of the minimum soil strength on which the vehicles can operate, the classes used to describe terrain for ground mobility purposes, the computer program used to predict dynamic response of the vehicles, and the effect of the driver's position on speed of the M60AlEl over abrupt surface irregularities, respectively. KEYWORDS: Mathematical models; Military vehicles; Mobility; Mobility models; Performance predictions; Tanks (Combat vehicles); Terrain factors; Vehicle speed; [Germany; M60AlEl tank;					
MBT70 tank]	(,	,		
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Vicksburg, Mississippi		26. GROUP			
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MOBILITY EXERCISE A (MFXA) FIELD TEST PROGR MILITARY VEHICLES IN SOFT SOIL, Volume 1	AM; REPORT 2,	PERFORMA	NCE OF MEXA AND THREE		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)					
Volume I of Report 2 of a series 5. AUTHORIS: (Piret Acade, middle initial, fact name)					
Barton G. Schreiner					
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	U. S. Army Materiel Command Washington, D. C.				
KEYWORDS: Field tests; Military vehicles; Trafficability: Vehicle design:	• •		•		

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Joseph L. Decell				
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	Washing	ton, n. C.		
The purpose of this study was to develop pertinent vehicle-lateral obstacle relations for three vehicle test beds (IEXA vehicles) and three conventional military vehicles all having approximately the same payload and to compare the performances of the MEXA vehicles with those of the conventional vehicles. An additional purpose was to develop a method of predicting the speed of a vehicle maneuvering in lateral obstacles. The vehicles were tested on a firm, level surface upon which was imposed a statistically designed array of obstacles at mean spacings of 14, 16, 18, and 20 ft. In 78 of the 113 tests conducted, continuous neasurements were made of vehicle speed, drive-line torque, and steering angle. In all tests, measurements were made of time elapsed and distance traveled. The data collected permitted the development of useful relations between vehicle width and minimum obstacle spacing negotiable, vehicle speed and obstacle spacing, vehicle steering angle and obstacle spacing, and vehicle speed and obstacle clearance. These relations were used to develop a simple method for relating the maximum speed a vehicle can develop to obstacle spacing that required only a knowledge of the vehicle width and its speed-traction characteristics on a firm surface. The conventional vehicles traveled faster and required less arduous steering than the NEXA vehicles. The maximum spacing required by each vehicle appeared to be a direct function of its width; all vehicles required the same minimum clearance on the driver's side. Appendix A describes the use of speed-obstacle spacing relations as input data for an analytical model KEYWORDS: Field tests; Malitary vehicles; Mobility; Obstacles; Performance predictions; Performance tests (Vehicles); Surface geometry factors; Mobility Exercise A				
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vicksburg, Mississippi		SE. GROUP	
3 REPORT TITLE			
MOBILITY EXERCISE A (MEXA) FIELD TEST PROG MEXA AND MILITARY VEHICLES IN VERTICAL OBS		+, PERFORM	ANCE OF SELECTED
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
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Newell R. Murphy, Jr. Adam A. Rula			
S. REPORT DATE	74. TOTAL NO. OF	PAGES	76. NO. OF REFS
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10 DISTRIBUTION STATEMENT			
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11. SUPPLEMENTARY NOTES	12. SPONSORING N	HLITARY ACTIV	VITY
	U. S. Army Washington	Materiel	Command
Fifty tests were conducted with two vehicle and the MEXA 10x10, 2-1/2-ton, wheeled, art test course at WES, on which rigid, single and shapes can be tested, was used. The production on the vehicle in the production on the vehicle for use as input diction model. A secondary purpose was to cle dynamics prediction models using test of the test are presented by curves relative speed of the vehicle at contact with the oblications on the vehicle, and obstacle height of 2.5 g's in the driver's compartment and compared with predicted results obtained from both vehicles. The results indicate among	ticulated test or multiple rimary purposed, and vert to the AMC-7 provide data data for the mag, for a serught versus special eversus special event com the dynam other things	obstacles obstacles of these cical accel (1 cross-co t for use in XM410E1 at xM450E1 of obstacles obsect for a ter of grav aic respons that: (a	ne vertical obstacle of various heights e tests was to obtain leration (at selected ountry mobility pre-in verifying the vehind MEXA 10x10. Results stacle heights, the celerations at selected vertical acceleration vity. Test data are se computer models for

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levels are reached only for vertical accelerations; (c) tire pressure can significantly affect peak acceleration relations; (d) for a given level of acceleration, speed decreases with an increase in obstacle height; and (e) with proper input the mathematical

Performance predictions; Performance tests (Vehicles), Ride dynamics;

models can be used to adequately simulate speed-obstacle height relations.

KEYWORDS: Cargo vehicles; Field tests; Military vehicles; Mobility; Obstacles;

Surface geometry factors; [Mobility Exercise A]

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MOBILITY EXERCISE A (MEXA) FIELD TEST PROG MEXA AND MILITARY VEHICLES IN VERTICAL OBS		4, PERFORM	ance of selected
4 DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Report 4 of a series a. AUTHOR(3) (First name, middle initial, last name)			
Newell R. Murphy, Jr.			
Adam A. Rula			
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	U. S. Army Materiel Command Washington, D. C.		
13 48STRACT			
Fifty tests were conducted with two vehicle	es, an XM410F	a1, 8x8, 2-	-1/2-von cargo truck
and the MEXA 10x10, 2-1/2-ton, wheeled, art			
test course at WES, on which rigid, single	or multiple	obstacles	of various heights
and shapes can be tested, was used. The pr			
data to relate obstacle height, vehicle spe			
locations on the vehicle) for use as input	to the AMC-7	l cross-co	ountry mobility pre-
diction model. A secondary purpose was to			
cle dynamics prediction models using test d			
of the test are presented by curves relating	ig, for a ser	les of obs	stacle neights, the
speed of the vehicle at contact with the ob- locations on the vehicle, and obstacle heigh			
of 2.5 g's in the driver's compartment and			
compared with predicted results obtained fr	venicie cent	ic respons	se computer models for
both vehicles. The results indicate among	other things	that: (s	the intensity of
vertical acceleration depends on the locati	on in the ve	hicle: (b)	human tolerance
levels are reached only for vertical accele	erations; (c)	tire pres	sure can significantly
affect peak accelaation relations; (d) for	r a given lev	rel of acce	eleration, speed de-
creases with an increase in obstacle height models can be used to adequately simulate s	; and (e) wi	th proper e height r	input the mathematical elations.
KEYWORDS: Cargo vehicles; Field tests; Mil.			
Performance predictions; Performance			
Surface geometry factors: [Mobility Exercise A]			

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PENETRATION RESISTANCE OF SOILS; Report 1,	TESTS WITH C	TRCOTAR FO	UTINGS IN AIR-DRY SANDS		
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s. AUTHORIS) (Phot memo, middle initial, lest name) Andrew J. Green					
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18 ABSTRACT		·			
The study reported herein is an analysis of the penetration of circular plate; and smooth-walled and rough-walled cylinders in two sands, each prepared at three strength levels. The penetration elements ranged from 2.5 to 61 cm in diameter, and the speed of penetration in all tests was 2.5 mm/sec. No basic differences were found in the shape of the penetration resistance curves for plates and cylinders, and the forces on the base of the cylinders were only slightly higher than those on the plates. The forces due to friction on the sidewalls of the cylinders were greater for the rough-walled cylinders than for the smooth, as could be expected, but they did not vary systematically with sand density in either case. Collapse of the data into a single function for sand was achieved by plotting a dimensionless pressure parameter P/rd versus a penetration parameter z/d. This gave evidence that pressure-similar relations, and thus bearing capacity, of large footings can be predicted from model texts. Dimensionless scaling relations and theoretical equations that include a friction angle term were also found to predict bearing capacity, but the problems in measuring a true friction angle make the use of these relations questionable for this purpose. The tests were deemed successful and eliminated irregularities encountered in the results of routine tests. The data should also be of great value in investigations of depth factors for bearing capacity of sand. This report will be supplemented by a report on similar tests in clay.					
KEYWORDS: Footings; Penetration r penetration tests	esistance	(Soils);	Sands; Soil		
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18 Assistant A study was conducted to determine	the Icasion	lity or u	sin; measurements made
with a multichannel gamma-ray spectrometer			
rately determining soil density and resolvi			
ments were first made on aluminum and steel	l blates to e	stablish	a standard reference
for comparing soil density. Two samples of			
densities to a depth of approximately 120 a	and 105 am fr	o nit 51	20 m long and 2 5h r.
wide. Measurements were made at depth inte			
located in the samples. The densities dete	ermined were	compared v	with densities deter-
mined by nonruclear means. Results of this	s study indic	ate that d	density can be measured
accurately by the method described herein p	orovided (_)	the thick	ness through which the
measurements are made is accurately measure			
are suitable for the distance over which th			
source and detector that was used permitted	te demonstration	Micaous cu.	
sult of this study, it is recommended that			
nondestructive soll density measurements wh	here the dens	ity beneat	th the surface of a
sample must be known.			
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KEYWORDS: Gamma ray spectrometer;	Nuclear m	ethods;	Soil density
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	Department of Washington,		•		
IS ABSTRACT	wasningcon,	<i>y.</i> c.			
This report is the third in a series and con					
relations of forces and displacements for fe	milies of ci	rcular for	tings (plates and		
cylinders). The report contains the basic of sults obtained from tests with circular plat					
inders in a fat clay prepared at two strengt	h levels.	The footing	s ranged from 2.5 to		
61 cm in diameter. In general, it was found	that a dim	ensionless	equation of the form		
P/c = f(z/d), where P is pressure, c is	soil cohesi	ion, z is	depth of penetration,		
and d is diameter of the footing, appears					
placements. However, the data suggest that, footing diameter below which the scaling law					
plot of the data obtained for the several si					
ing bearing capacity equations. The measure					
base of the footings) versus depth of penetr					
computed by the Meyerhof equation than with	those comput	ted from B	rinch Hansen's		
equations.					
KEYWORDS: Clays: Footings; Penetra	tion resid	statica (G	Soils): Soil		
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PERFORMANCE OF BOEING-GM WHEELS IN A LUMAR	SOLF STHOP	MI (BYZYFI	• •		
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Superseded by Technical Report M-71-10.					
Report 1			Space Flight Center es and Space Administra-		
		tsville,			
18. ABSTRACT					
Six versions of the Boeing-GM metal-elasti					
soil simulant (crushed basalt that was pro					
approximately the same as that of samples					
to determine their relative performance. cover a range of cohesive and frictional p					
assumed to exist on the moon. Programmed-					
ted with the U. S. Army Engineer Waterways					
mometer system. Data indicated that the					
50 percent of its contact surfact may be s					
accumulated in the wheels during the tests	and the an	ount seeme	ed to vary linearly		
with slip. Less soil accumulated in the 5					
than in the open-mesh one. Pull/load incr					
at 15 to 25 percent slip for all wheels, t					
This suggests that the operation of a vehi					
protracted periods invites immobilization,					
as would occur if a soft soil spot or a st					
denly, would probably induce 100 percent s also rose rapidly at slips beyond 15 to 25					
the practical wisdom of using 20 percent s	, hercent, ,	um from uh	ich to company the		
performance of wheels (and vehicles).	ash as a mar				
KEYWORDS: Flexible wheels: Laboratory tog	ts: Lunar ro	vino vehic	lee. Innor entle: Slin		
KEYWORDS: Flexible wheels; Laboratory tests; Lunar roving vehicles; Lunar soils; Slip					

KEYWORDS: Field tests; Lunar soils; Obstacles; Soil-track interaction; Tracked vehicles; Elastic Loop Mobility System

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AN ANALYSIS OF GROUND MOBILITY MODELS (ANAM	na)					
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	Washington					
13. ABSTRACT						
A study aimed at the analysis of existing g						
Inc., under contract to WES. The objective						
ground mobility models in order to: (a) de						
applicability to predicting cross-country po						
world; (b) select the models that appear to						
determine their usefulness and applicability areas of the latter models in which addition						
lines for future development of ground mob						
unclassified literature were canvassed for						
been used or seriously proposed. Ten cross	•	•				
examination. The study produced a compendi						
, , ,						
comprehensive cross-country vehicle performance models that have been used or have a potential for future use. A structure for a NOW cross-country ground mobility model is						
suggested, along with some minor additions	suggested, along with some minor additions that do not require a great amount of effort.					
The study also presents a list of guideline						
mobility models along with plans for a futu-						
a main text containing an introduction, a p						
models, a description and analysis of cross-						
NOW comprehensive cross-country model, and	guidelines an	d plans fo	or future development			
of ground mobility models; and two appoints						
models (Appendix A) and stream-crossing models						
REYWORDS: Military vehicles; Mobility; Mob	ility models;	Performan	nce predictions; State-			
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This introductory report reviews approache				
track 'ystem and describes in detail the f				
that the U. S. Army Engineer Waterways Exp				
hensive, quantitative description of the b port also includes a comprehensive list of				
the soil-track system. The laboratory mod				
large-scale single-track system designed f				
arrangement. Initially, the model track w				
pendent parameters for tracks operating in will be used to develop a means for predic				
Tests to determine track performance in la				
final stages of the program, the data deve				
existing track performance theories and, i				
tests will then be conducted to determine				
performance prediction terms must be modif				
Appendix A describes the Plackett-Burgan t the most important variables of the system				
presents the Waterways Experiment Station				
franchista and managed and makes where a gardon				
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KEYWORDS: Glossaries; Laboratory tests; S		teraction;	State-of-the-art	
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Tallahassee, Fla., as thesis for Master of	Washingt	on, D. C.	
Science degree in Statistics	<u> </u>		
A first-generation, quantitative of	description	of straight	t-line track pull per-
formance in a desert sand was sought by labor			
ables selected to provide a comprehensive de	escription o	f the track	k-sand system, analy-
sis of three Plackett-Burman (statistical)	test designs	showed for	ur to merit initial
studysoil strength G, track width b, track			
or similitude were used to develop three dir	rensionless,	independe	nt terms P_{20}/W , b/ ℓ ,
and $G\ell^3/W$ to express the functional relation	on among the	se variable	es and P ₂₀ (pull at
20 percent slip, i.e. near-maximum mull). I	Data analysi	s demonstra	ated that the last
two terms can be combined to $G(bl)^{3/2}/W$. A least-squares fit of P_{20}/W to log $[G(bl)^{3/2}/W]$. Values of a ₀ and a ₁ in P_{20}/W	simple line	ar regress.	ion determined the
least-squares fit of P ₂₀ /W to log [G(bl)]	/W] as P ₂₀ /W	= 0.204482	2 + 0.161470 log
$[G(bl)^{3/2}/W]$. Values of a ₀ and a ₁ in P ₂₀ /W	= a _Q + a ₁ 1	og [G(pr)]	'-/Wj were relatively
istable in regression of data subgroups sebai	rated by the	Tevers at	Which G. D. E. and W
were tested. Comparisons of linear regress: (with x + x = 3.0 and values of x, and x	ions of form	$P_{20}/W = a_{y}$	$_{0}$ + a log (Gb $^{-1}\ell^{-2}/W$)
(with $x_1 + x_2 = 3.0$ and values of x_1 and x_2 optimum prediction term to be $G(bl)^{3/2}/W$.	varying from	nōto 3)	also indicated the
optimum prediction term to be $G(bl)^{3/2}/W$.	Finelly, t	he equation	n from a multiple
linear regression of Poo/W on log G, log b,	log I, log	W did not o	describe the test data
significantly better than did the simple lin	near regress	ion. From	equation $P_{20}/W = 8_0 +$
$a_1 \log [G(b^2)^{3/2}/w]$, expressions were obtain k, and e, where $k = G(b^2)^{3/2}$, for two performs	ned for P20,	W, and P20	\sqrt{W} in terms of a_0 , a_1 ,
k , and e , where $k = G(ot)^{3/2}$, for two performs	rmance level	s of partic	cular interest, the
maximum-pull and zero-pull conditions.			
KEYWORDS: Laboratory tests; Mathematical mo-	dels; Mobili	ty numbers;	Performance pre-
dictions; Savas; Suil-track inter	action; Trac	k performan	nce; Trafficability

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PREDICTION OF THE SLOPE-CLIMBING CAPABILITY	OF ELASTIC	RIM WHEELS			
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c. Task 01, Military Aspects of Off-Road	SO. OTHER REPOR	T HO(B) (AND OF	her numbers that may be avolged		
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13. AOSTRACT					
A new semiempirical approach was attempted					
wheels. This approach consisted of determine		•			
on yielding slopes by two extrapolations: pull performance of flexible wheels on unyi					
mentally determined performance of rigid wh					
is a prediction equation for the available					
larly simple case of pneumatic tires) on de	formable, in	clined soi	ls in terms of soil		
deformability, cohesion, and internal frict					
angle. Various reduction factors developed					
account were adjusted to satisfy known cond					
compatible. By solving the prediction equal capability can be determined; and by solving					
ratio on level ground can be obtained. Alt					
it matches the extreme conditions on both					
spectra and is thought to describe intermed					
	confidence. The equation has been checked numerically only for the test conditions				
provided by elastic-rim wheels (Bendix lunderedeformation characteristics that were neede					
approach. The more complex behavior of tir					
study.					
KEYWORDS: Flexible wheels; Slope performance	ce; Cril-whee	l interact	ion		
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EFFECT OF YAW ANGLE ON STEERING FORCES FO	K THE LUNAK	KOATM' AFU	ICLS WREEL	
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yaw angles ranging from -5 to +90 deg. The				
365 N), and the speed was varied from 3.5 to				
was noted that speed had an effect on side				
derth, and skid generally increased as the				
loads used, the effect of load on performan	ce was not s	ignificant	•	
KEVEGEDS: Lunar rowing vehicles: Soil-whee	l interactio	n: Steerins	z; Wheels	
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mance of dual wheels at zero spacing with the termine the influence of tire spacing on duconducted on air-dry, medium dense to very powered wheels in terms of pull, torque, an all at 20 percent slip, and for towed wheel. The existing WES performance prediction systhat a powered dual wheel at zero spacing, and exhibiting equal performance, outperfor istics as each wheel of the dual-wheel confidence wheels. This critical spacing was rhalf times the width of one of the wheels. as one wheel, performed practically the same teristics of the dual-wheel configuration; performed more efficiently than the single tion, and soil strength combinations. Litt the towed condition. Qualitatively, the towheels than for a single wheel, its magnitumes.	the performa- ual-wheel per dense sand. In sinkage considered singulation. In singulation the sand a single singulation and a single singulation and a single singulation. In a dual whence as a single however, the wheel over the could be swed force cowed and singulation and singulati	nce of sing rformance. The data oefficients of towed for d in both (as two where e wheel with The perfor the two where it became el at zero le wheel with e dual where a certain in concluded oefficient	gle wheels and to de- One-pass tests were were analyzed for s and of efficiency, orce coefficients. cases. Results showed els sharing equal load th the same character- mance of powered dual els performed like two to three and one- spacing, considered ith the same charac- el with zero spacing range of load, deflec- from the analysis of was larger for dual	

KEYWORDS: Laboratory tests; Performance predictions; Pneumatic tires; Sands; Soil-wheel interaction; Tire performance; Trafficability; Twin wheels

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Sir versions of the Roeing-GM wire-mesh whe consisting of a crushed basalt with a grain-size dist Apollo 11 and 12 flights, to determine their relative to cover a range of cohesive and frictional properties moon. Programmed-slip and constant-slip tests were of periment Station single-wheel dynamometer system. The tread over 50 percent of its contact surface was slig amount of soil accumulated in the wheels turing the tin the 50 and 75 percent observed wheels than increasing slip to a near maximum of 15 to 251 slip if wheel slip to 100% slip. This behavior suggests that for protracted periods would result in immobilizing the required to negotiate a soft soil spot or a steeper a wheels tested, as depicted by the power number, also indicate that the wheel performance at 20% wheel slip limiting mobility performance capabilities of several Vehicle (LRV) wheel type. Following the selection of interaction tests were conducted in the lunar soil si Appendix A describes in detail the WES tynamometer sy	ribution simil r performance ss to simulate conducted with re performance the performance this superior rests varied lie in the operation the operation the vehicle, as those rapidly a provides a re versions of the the deeing-GM mulant and are	ar to that of The consiste soil condition the U. S. Arm of the wheel to that of the mearly with a sh one. Pull then increas of a vehicle would be the Specific pow t slips beyon asonable meas companies of CMC wheel for L reported in	samples collected during ency of the soil was varied sons assumed to exist on the my Engineer Waterways Excepted with a metal chevron their tread designs. The clip. Less soil accumulated fload increased rapidly with ed slowly with increasing at slips higher than 25% case if the vehicle were were requirements for all ad 15 to 25%. These trends were for comparing the (wire-mesh) Lunar Reving EN, Additional wheel-soil Seport 2 of this series.
KEYWORDS: Laboratory tests; Lunar tests (Vehicles); Soil- GM wheels]			

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and soil strength on the Wheel performance			
programmed-slip tests were conducted with			
ment Station single-wheel dynamometer syst			• •
formance of single LRV wheels in terms of			
ficiency were not influenced by wheel spee			
presence of a fender, or wheel load. Of t	hese variabl	les, only 1	oad influenced
sinkage, which increased with increasing l			
ficient and power number increased with in			
given pull coefficient or slope, slip was			
number decreased and efficiency increased	with increas	sing soil s	strength.
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Field tests; Mathematical models; Obstacles; Ride

KEYWORDS: Military vehicles; Mobility models; Off-road mobility; On-road mobility; Performance predictions

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A NUMERICAL MODEL OF THE RIDE DYNAMICS OF	A VEHICLE USI	NG A SEGME	ENTED TIRE CONCEPT	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report				
3 AUTHOR(3) (First name, middle initial, last name)				
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to Mississippi State University, State College, Mississippi, as thesis for degree of Master of Science, Engineering Mechan- ics, College of Engineering.	U. S. Army Research,	Materiel Developmen		
The purpose of this study was to develop a the ride dynamics, including bounce, pitch axle vehicle with an arbitrary number of a minimize the execution time and thus the condetermination of the optimum numerical int in the simulation. The numerical integrat method, which is a fourth-order method. To uations per integration and provides an escaped for automatic interval adjustment. For traversing a single obstacle at three difference speed were simulated. Graphs are present the field test data provided by the Water	, and roll, or xles. The stoot of the signation into ion method us the method rectimate of the ield tests of erent speeds ented comparis	of a general day also is mulation be created to be determined to be truncation are presented and a crossing simulations.	al single-hull, solid- included an effort to by providing automatic e used at each point e Runge-Kutta-Merson e derivative eval- on error that can be entative vehicle as-country terrain at ted vehicle responses,	

KEYWORDS: Computerized simulation; Flexible wheels; Ride dynamics; Vehicle dynamics

integration step-size on simulated vehicle responses are illustrated with graphs comparing simulated vehicle responses using several different integration intervals. A discussion of criteria for automatic management of the integration interval is

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VEHICLE/ROAD COMPATIBILITY ANALYSIS AND MOI	DIFICATION SY	STEMS (VRC	ams)
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
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3. AUTHOR(5) (First noem, middle initial, last name)			
Victor C. Barber			
Newell R. Murphy			
A REPORT DATE	TA. TOTAL NO. O	PAGES	76. NO. OF REFS
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13. ABSTRACT			
The Vehicle/Road Compatibility Analysis and	i Modificatio	n System (VRCAMS) brings together
the appropriate disciplines pertinent to ve	chicles, mobi	lity, road	geometrics, structures
and maintenance to determine and measure th	ne compatibil	ity of veh	icle and its environ-
ment and the resultant product of movement.			
constructive or destructive modification of impact on vehicle movement. The first-generation	venicie and	/or enviro	nment and the resultant
successfully combine all known parameters a	eracion syste	e, in comp	uter code, serves to
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grammed improvements to the system imply si			
of road deterioration analysis, vehicle rel	liability ana	lvsis, veh	icle-road ontimization.
and overall allied material optimization.			
that respectively treat mobility and ride of			
teristics, maintenance, and vehicle movemen	1: The para	meters in	each of the subsystems
are brought together in a comprehensive man	wer to provi	de output	data pertinent to
vehicles moving on roads. Outputs provided	i by the VRCA	MS include	speed of given vehi-
cles on specific road segments, traffic vol various levels of service, structural life			

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vehicles, and improved logistical and tactical planning. KEYWORDS: Mobility models; Road capability models

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quantities of traffic, maintenance requirements to extend road segment life, and delivery rate and travel time for vehicles on road segments. Refinements and additions to the current model will provide for a greater degree of accuracy and for a broader range of applications such as road and vehicle design optimization, optimum use of roads and

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A brief review is presented of the current the ground-flotation requirements for landi aircraft, and criteria for estimating cross Discussions are also presented of three soi Ratio (CBR), airfield 'ndex (AI), and cone helicopter tires in prepared and natural so among soil strength, towed motion resistanc and maximum-drawbar-pull capabilities of se the distribution of terrain factors mapped probability of moving helicopters over the system is completely adequate for character timating performance of all aircraft and all The CBR system appears to be adequate for p CBR above about 2.5 when estimating the gror relating the requirements to the design cap lished criteria. The CI system has been us strength for the purpose of estimating performance of estimating performance. Limited testing reported herein is successfully for estimating the soil streng over unimproved terrain; therefore, a procequirements for helicopter landing gear can improve the strength; Soil-wheel futers	ng gear of ai -country peril atrength paindex (CI). ils are prese of some assilected ground in a selected ground vehi repared surfaund-flotation abilities of ed successful ormance of grandcates that the requirement of the requirement of the requirement of the made. Helicopter	ircraft, particular formance of arameters: Results of ented, and sumed helical vehicles. It west Germanditions for its and understanding the cound vehical the CI systs for movestablished.	articularly fixed-wing military vehicles. California Bearing tests with three relations are shown copter configurations, Also presented is an transect and the all strength measuring for the purpose of estable prepared surfaces with ents of aircraft and according to estables on unimproved estem can be used the ent of helicopters wherein design re-	
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19 ABSTRACT				
A mathematical model bearing on aspects of reles is described in this report. The structure model are complementary to those of the AMC-product of the vehicle reliability model is lowing: "The probability of no failure of so of 174 miles and a maintenance history of in 74 percent during traversal of 25 miles of the effect is 35 percent in excess of standard so made for a given vehicle traversing terrain obtained directly from AMC-71. Probability ability density functions for the vehicle contained directly from AMC-71. Probability ability stresses previously identified a numbers of component and vehicle failures, ourse, and inherent availability. Problems of aspects of the model are speculative in that available: (a) specification of and testing imparting standard stresses to reliability ability due to departures of stresses from the are presented, including one that uses data demonstration program for the XM705 vehicles KEYWORDS: Maintenance; Mathematica	eture and com- -71 Ground Mc a probabilit an M60 tank h mmediate repl terrain havir stresses." Sof given att data are rec mponents obt as standard. elfective veh of data acqui t direct date g at condition and (b) chare their standar gathered dur s.	mputational obility Modely statements and a lacement or ong stresses statements tributes. Quired in the tained under other out thick mean is it ion are sources as sources as sources acterizing rd values.	l attributes of the del. The principal of such as the fol-accumulated mileage f failures is s whose cumulative of this nature are Pertinent data are the form of prober conditions of tputs are expected time between failed iscussed. Two are not presently rain regarded as changes in reliseveral examples tensive reliability	
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PERFORMANCE EVALUATION OF A SECOND-GE	INERATION ELASTIC LOOP MOBILIT	TY SYSTEM			
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Klaus-Jergen Helzer					
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* ABSTRACT					

Tests were conducted to evaluate the mobility performance of a second-generation Elastic Loop Mobility System (ELMS II) developed by Lockheed Missiles and Space Company for the National Aeronautics and Space Administration (NASA). Performance on level test lanes and slopes of lunar soil simulant (LSS) and obstacle-surmounting and crevasse-crossing capabilities were investigated. In addition, internal losses and contact pressure distributions were evaluated. To evaluate the soft-soil performance, two basic soil strengths tested during recent studies for NASA related to the mobility performance of the LRV. Data indicated that for the tested range of the various performance parameters, performance was independent of unit load (contact pressure) and ELMS II drum angular velocity, but was influenced by soil strength and ELMS pitch mode. Power requirements were smaller at a given system output for dense soil than for loose soil. The total system output in terms of pull developed or slope-climbing capability was la ger for the ELMS II operating in restrained-pit.r mode than in free-pitch mode. The angle of the maximum slope that the ELMS II climbed in free-pitch mode on dense soil was 35 deg; on the same soil, but with the system operating in restrained-pitch mode, the angle of the maximum climbable slope was 34 deg, and on love soil, it was 27 deg. The smaller maximum slope angles for restrained-pitch mode resulted from load being transferred from the ELMS II to the trailer, which was used during the slope tests to stabilize the single unit. If this load transfer can be overcome, for example by replacing the trailer with a second powered unit, this two-unit ELMS should be able to climb slopes with angles up to 38 deg on dense soil and up to about 35 deg on loose soil. The slope-climbing capability can be estimated from results of tests conducted on level ground. The maximum rigid-step obstacle surmounted was 46 cm high, and the maximum crevasse crossed was 100 cm wide. It can be assumed from the ELMS performance during these tests that obstacles and crevasses with larger dimensions could be negotiated if the trailer were replaced by a second powered ELMS II unit with a pitch-control system in the linkage between the units. Internal losses were smaller than those of the first-generation ELMS for torques up to about 60 percent of the total available torque; for higher torques, the reverse was the case. The contact pressure distribution along the longitudinal axis of the loop showed maximum contact pressure occurring toward the middle of the loop, whereas the transverse cross-sectional distribution showed pressure concentrations at the loop edges. The ELMS II showed an overall superior performance as compared with that of the first-generation ELMS and the wheels used on the U. S. Lunar Roving Vehicles.

KEYWORDS: Elastic loop mobility system; Lunar roving vehicles; Lunar soils; Mobility; Wheels

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with poor traction due to weak soils or slippery surfaces are not lighted to rigid or pneumatic-tired wheels, but also affect powered track wheels with grousers. Two approaches have been followed in attempting to solve the soilwheel interaction problem: an analytical approach based on the elastic solution of a plane strain problem, and an experimental approach based on the relationship between the shear and normal stresses that may occur within the vicinity of or at the interface of the soil and the wheel of a moving vehicle. The analytical solution is based on the assumption that the stresses within the soil are the results of the tangential and radial stresses created by a wheel partially embedded in soil with an impending rotation. The Airy stress function was used in representing the stresses within the soil in terms of analytic functions. The Schwarz-Christoffel equation was used to transform the geometry and the boundary condition of the region beneath the wheel and to match them with the stress functions. The Cauchy integral equation was applied on the transformed boundary conditions to obtain the shear and normal stress at any point within the region of the soil-wheel system. A computer program for reducing the results and obtaining numerical values of the stresses at any point within the vicinity of the wheel was also written. is believed that the analytical solution developed will permit the evaluation of stresses within the soil beneath a wheel that result from various combinations of radial and tangential stresses. The experimental investigation was designed to investigate the shear stresses and traction forces that may exist vetween a model rigid wheel or tire wheel and the supporting soil. CH material (Vicksburg buckshot clay) was compacted and tested in an annular torsion shear machine. Four types of specimens were tested in this study: the first series of tests consisted of shearing homogeneous soil specimens; in the second series, the soil was sheared against smooth rubber; in the third series, the soil was sheared against polished stainless steel; and in the fourth series, a nonhomogeneous soil specimen, with upper and lower halves having different water contents, was sheared. The initial normal stresses used in the test program were 5, 15, and 30 psi, and all specimens were sheared under constant-volume conditions at rates of shear deformations of 0.002, 0.2, and 2.0 in./min. Test results showed that nonhomogen-as soil specimens with upper and lower halves having water contents of 26 and 16 percent, respectively, were stronger than homogenous soil specimens with a uniform water content of 26 percent and that the strengths of both types of soil specimens were higher than those at the interface of smooth rubber or polished stainless steel and soil. Test results showed that the strength of nonhomogeneous soil specimens was higher than that of homogeneous soil specimens with uniform water content, and the strengths of both types of soil specimens were higher than those at the interface of smooth rubber or polished stainless steel on soil. The results also showed that the shear resistance developed between soil and rubber is much higher . In that developed between soil and polished steel. The shear stress at failure for all test series showed an increase with increasing initial normal stress and increasing rate of shear deformation. The shear stresses at the interfaces of smooth rubber and soil and also of polished steel and soil dropped sharply when the plane of contact was covered with a film of water. The peak shear stress obtained from each test series was plotted as a function of the corresponding normal stress in order to facilitate its use in analytical solutions.

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20. ABSTRACT (Continued)

will predict the performance of the small tire as accurately as it predicts the performance of a large tire. The system also can be used in predictions for layered-soil systems, if the soil strength of the top layer is used in the numeric and as long as the lower layer is relatively strong in relation to tire loading. When the soft upper layer becomes thin, the primary phenomenon is lubrication of the firm lower layer by the soft upper layer, and a different mechanism is involved. When a relatively thick soft layer overlies a hard one, the change in pull performance increases as tire deflection is decreased for a given top-layer thickness and wheel load. As values of the clay mobili'v number increase, the critical thickness of the top soil layer decreases and the change in pull performance decreases. Torque performance does not change with the ratio of top-layer thickness to tire section width. When a hard layer overlies a soft one, pull and torque performance show slight tendencies to decrease with thickness of the top layer. Torque requirements increase when the tire breaks through the hard layer into the underlying soft layer. Generally, it is suggested that efforts be directed toward investigations of thinlayered soil systems instead of pursuing further the problem of thick-layered soil systems.

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	Washington, D. C.		
The polecat, an articulated vehicle, tests on snow ranging from 1-1/2 to 4 created slightly deeper ruts, but snow about the same for both vehicles. The below the rut surface was slightly less more drawbar pull in towing and requiremented more drawbar pull in towing an polecat excelled in comfort and maneuremoldable soils are recommended.	ft deep. Results she attrength and densite depth to which stress for the polecat. red less when being the requires less when	owed that the polecat y in the ruts were sses were induced The polecat exerted owed. The polecat being towed.> The	
KEYWORDS: Articulated vehicles; Field Snow trafficability; Tracke			

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3. REPORT TITLE	· ——————	<u></u>	· · · · · · · · · · · · · · · · · · ·
A LIMITED STUDY OF FACTORS THAT AFFEC	T SOIL STRENGT	i	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report		~	
S. AUTHOR(S) (Last name, first name, initial)			·
Knight, S. J. Rush, E. S.			
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ability of Soils as Related to the			
Mobility of Military Vehicles			
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	Chief of E		
	Washington	, D. C.	20315
13. ABSTRACT			
To obtain an approximate measure of tences on the strength of a soil, its compared to its strength under simila and density. The test area was locat uniform in type and decreased in mois giving a wide range of moisture and s was tested for moisture, density, and laboratory, and for remolding index i that (a) the cone index of a given sa varies with the structure and compact effort, difference in water-holding c ratory treatment, and surcharge are t density-strength-moisture content rel	strength under r laboratory come on a lake slure content with trength conditions in the field. Imple at a given ion history of apacity of the he principal for	natural conditions nore when ith diste ions. Th its natural principal n moistur tre sam soil in	conditions was s of moisture content re the soil was very ence from the lake, ne soil, a heavy clay, aral state and in the l conclusions were re content and density ple, and (b) compaction situ and after labo-
KEYWORDS: Clays; Field tests; Fine gr moisture; Soil property rel Laboratory #c.K	rained soils; Soil so	oil densi trength;	ty; Soil Trafficability

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	Chief of Eng		
	Washington,		
13. ARSTRACT	<u> </u>		
This report presents soil and meteorol months (June, July, and August) of 195 at Alert and Kould Bay, and during Jur At each weather station, three test si one at an intermediate elevation, and moisture content, density, depth to percorded. The data were not sufficient moisture and meteorological parameters of trafficability conditions at the the	55 at the Arct; e-September 19 ites were estal one at a high ermafrost, and it to determine s, but did per	ic weathe 954, 1959 blished- elevation meteorole relation nit an ap	er stations located 5, and 1956 at Eurekaone at a low elevation on. Come index, logical data were ons between soil pproximate evaluation
KEYWORDS: Arctic regions; Field tests;			

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AERIAL PENETROMETER DEMONSTRATION AT	FORT RUCKER, AL	ABAMA	
4. DESCRIPTIVE HOTES (Type of report and inclusive dates)			
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S. AUTHOR(5) (Last name, first name, initial)			
Rulz, A. A.			
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	Washington,		
A demonstration of the performance of conditions was given at Fort Rucker, Research Center and was attended by r of obtaining data that might widen th trometer relations. This report pres data collected, and compares the relasimilar ones developed for other soil 1, 2, and 3).	Alabama, by the epresentatives e knowledge of ents the soil a tions developed	Air For of WES w soil pro nú penet from th	ce Cambridge with the objective operty-aerial pene- crometer-performance sese data with
KEYWORDS: Aerial cone penetrometers; strength relations; [Fort Ro	Field tests; Mi	litary b	ases; Soil

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	Chief of Engineers Washington, D. C.	5, DA
	Washington, D. C.	
13. ABSTRACT		
A limited test program was conducted t	to compare the perform	nances of the M135 and
M211 2-1/2-ton military cargo truch:	while operating with	and without snap-tracs
on a silty, wet soil. The vehicles go	we limited performan	ce while operating
without the traction device, but great	tly improved performan	nce when they were
equipped with snap-tracs. It was cond	cluded that the use of	snap-tracs did not
improve their traction characteristics	in an extremely wet	, sort, suppery soil.
However. it was not possible to determ of the snap-tracs "open" and act like	aine positively wheth	bool Additional toots
are recommended to compare the perform	grousers wider the w	neer, Address with the
performance of snap-tracs with the C-	though member looked	in place and with the
	shaped member locked	in place and with the
C-shaped member removed.		
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KEYWORDS: Cargo vehicles; Field tests	: Military vehicles: 1	Mobility; Soil-track
interaction; Traction devic	es; Trafficability; []	1135 cargo truck; 🕜
M211 cargo truck]		- 7.
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EFFECT OF HOLD SIZE AND OTHER FACTORS	ON LABORATORY CONE INDEX MEASUREMENTS
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Final report	
S. AUTHOR(S) (Lest name, first name, initial)	**************************************
Green, A. J.	
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	Chief of Engineers, DA
	Washington, D. C. 20015
13. ABSTRACT	
A brief study was made to determine the	e effect of mold size on cone index. Three
fine-grained soils (two silts and one)	neavy clay), with cone indexes ranging from
20 to 250, were tested in molds ranging	from 1.9 to 15.5 in. in di meter. The
variables, other than mold size, were p	maintained as mear constant as practicable
and did not significantly affect the co	one index values recorded. Results showed
	are content and density, decreasing the
	index until a certain minimum diameter was
reached; use of molds below this minimu cone index values than would have been	
	d diameter versus cone index was established
Use of mold sizes equal to or above thi	is curve should produce come indexes that
are relatively free of the confining ef	ffects of the mold. It is recommended that
this average curve be used as a guide i	in the selection of minimum mold diameters
for laboratory investigations of the st	rength of fine-grained soils.
KEYWORDS: Cone index; Laboratory equipm	ment; Laboratory tests; Soil
strength; Soil strength test	instruments; Trafficability

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PILOT STUDY TO EVALUATE THE SQUEEZE TE	ST FOR USE IN N	ÆHICLE-	HOBILITY RESEARCH
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Green, A. J., Jr.			
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	Chief of Engi Washington, I		
13 ABSTRACT	<u> </u>		
The Jurgenson squeeze test was studied as an aid in understanding the strength vehicle-mobil. Ty research. The squeeze quire expensive equipment. Its results other strength tests including cone perstudy support the theory that the squee of the soil, whereas the triaxial test plane. The squeeze test is considered tory vehicle-mobility research programs	h-deformation per test was easy securelated we metrometer measeze test determine assures the secure suitable for i	propertion to per call with surement call strength	es of soils in form and did not re- the results of the s. Results of this e average strength along the weakest
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S. AUTHOR(S) (Last name, list name, initial)			
Pula, A. A.			
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Chief of Engineers, DA Weshington, D. C. 20315			
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13. ABSTRACT

Four sites in the Canal Zone were studied to determine whether the techniques used to develop a soil moisture prediction system for temperate-climate soils could be successfully applied to tropical-climate soils. Soil moisture and strength data were collected weekly at the sites, and climatological data daily, for 18 months. Actual soil-moisture contents on the starting date were used to start the predictions. Comparison of predicted and measured soil moistures indicate that: (a) the techniques used to develop a soil-moisture prediction system for temperate climate could be successfully applied to tropical soils: (b) the average soil-moisture predictions developed from temperate climate data can be used with some success on tropical soils; (c) the quality of moisture content-strength relations for tropical soils is considerably lower than similar relations derived for temperate-climate soils. Conclusions regarding trafficability of the region during the wet sesson were: (a) upland soils are generally trafficable though wheeled vehicles may fail to climb slopes because of slipperiness; (b) lowland soils are generally trafficable only for low-ground-pressure tracked vehicles.

KEYWORDS: Soil moisture prediction; Trafficability prediction; Tropical regions; [Panama Can: 1 Zone]

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this study.	Washington,	D. C. 2	20315
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13. ABSTRACT			
The soil-moisture prediction method pr	eviously found	applica	ble to U. S. sites was
found applicable also to 8 Puerto Rico			
based on data collected at these 9 sit			
22 other sites in Puerto Rico; predict			
what less accurate, principally becaus	e soil-moistur	e deplet	ion rates in Puerto
Rico are considerably different from t (a) Puerto Rico soils do not lose mois			
of loss seems to be unaffected by seas			
moisture depletion in the surface to 1			
1/2 the average summer rate and about			
climates of the U.S. Soil-moisture c			
index and rating cone index but poorly	with remoldin	g index.	
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KEYWORDS: Soil moisture prediction; Tr	efficability n	rediction	n: Tropical regions:
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McDaniel, Alvin R.			
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	U. S. Army Washington,		
13 ABSTRACT	·—··—·		
Soil trafficability studies have shown importance to vehicle mchility and var therefore, a means of predicting moist forecasting of soil trafficability. I Station soil-moisture prediction method cated in the Panama Canal Zone to determ the prediction of moisture content of predictions were obtained at specific method is applicable to Panama soils. influence on soil-moisture depletion swas rapid. An analysis of strength dattween moisture content and cone index, moisture content and rating cone index content and remolding index. On the bof the residual soils was considered gland soils was considered good during season.	ies principally are content of the U.S. Army of for U.S. so armine whether tropical soils sites, and an Groundwater dince drainage tha showed a him and a leaser. No relation asis of rating cod. Traffical	y with s a soil Engineer ils was the meth Facto lysis of id not t from the ghly sig degree was fou come ir	is essential to the Waterways Experiment applied to sites lo- mod was applicable for ors necessary for the Mata shows that the mave an appreciable of the 12-in. layer gnificant relation be- of significance between mod between moisture and between moisture dex, the trafficability of the alluvial marsh-
KEYWORDS: Soil-moisture prediction; Tr [Panama Canal Zone]	rafficability p	redictio	on; Tropical regions;
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13. ABSTRCT			
The U. S. Army Engineer Waterways Ex			
diction method for United States soils was	applied to	sices in C	Colombia to determine
whether the method was applicable for the	prediction of	of moisture	content of tropical
soils.	-		-
Data were collected at four prediction	on developmen	nt sites in	the subhumid climate
of the "Sabana de Bogota" located in the			
in soil-moisture cortent, soil density, a	nd soil stren	ngth with d	changes in weather
conditions were investigated periodically	for one year	r.	-
These data were analyzed and used to			sture content and to
establish the relation between soil moist			
show that the WES soil-moisture prediction			
moisture content at the four sites in Cole			
establish soil-moisture depletion cur es			
			e corrected designer.

moisture content.

Basic data and photographs for each test site are included as Appendix A.

indicated by rating cone index, was good even when the soils were at maximum

to establish accretion relations. Relations were established between soil-moisture content and soil strength at all sites. Trafficability of the soils tested, as

KEYWORDS: Soil moisture prediction; Trafficability prediction; Tropical regions; [Colombia, S.A.]

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Trafficability and Mobility Research Report 5				
				«Task-02, Surface Mobility
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Soil trafficability studies have shown that the strength of a soil is of major impo tance to vehicle mobility and varies principally with soil moisture; therefore, a means of predicting moisture content of a soil is essential to the forecasting of soil trafficability. The U. S. Army Engineer Waterways Experiment Station (WES) soil-moisture prediction method for United States soils was applied to sites in Costa Rica to determine whether the method was applicable for the predition of moisture content of tropical soils. Data necessary for the predictions were collected on five sites in the Premontane wet climate of the Reventazón Valley at Turrialba, Costa kica. Changes in soil moisture content, density, strength, and remolding strength wit changes in weather conditions were investigated at regular intervals for 25 months. These data were analyzed and used to predict soil-moisture content and to establish the relation between moisture content and soil strength. The analysis shows that the WES method is applicable to prediction of soil-moisture content at the five sites in Costa Rica. Groundwater did not have an appreciable influence on soil moisture depletion since drainage from the 0- to 12-in. (0- to 30.5-cm) soil layer was related directly to rainfall. Topography was shown to influence soil-moisture content to some degree. Analysis of strength data showed a highly significant relation between soil strength and moisture content. On the basis of rating cone index, the trafficability of the soils was considered poor during the wet season and good during the latter part of the dry season. Basic data and photographs for each test site are included as Appendix A.

KEYWORDS: Soil moisture prediction; Trafficability prediction; Tropical regions; [Costa Rical

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KEYWORDS: Soil moisture prediction; Trafficability prediction; Tropical regions;

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except during the extremely wet period. Basic data and photographs for each test site

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TRAFFICABILITY PREDICTIONS IN TROPICAL	SOILS; Report 7,	HAWAII ST	UDY	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Report 7 of a series				
S. AUTHOR(S) (First name, middle initial, last name)				
C. A. Carlson				
W. P. Bonnert, Jr.				
M. P. Meyer				
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Soil trafficability studies have shown tance to vehicle mobility and that stre therefore, a means of predicting moistu	ngth varies prin	cipally wi	th soil moisture;	

tion between soil moisture and strength are essential to the forecasting of soil trafficability. The U. S. Army Engineer Waterways Experiment Station soil-moisture prediction method was applied to sites in Hawaii to determine whether the method was valid for the prediction of moisture content of these tropical scils. Data were collected from January 1960 to June 1961 at 34 sites, on three Hawaiian islands, representing the major soils, weather regimes, terrains, and land uses in Hawaii. The data from 11 sites were analyzed and used to predict daily soil moisture contents, and data from all sites were used to determine the relations between moisture content and soil strength. The moisture prediction method was found valid. Relations were found between moisture content and strength, but at many sites they were poor due to the variability of the soil. In terms of rating cone index, the trafficability of the upland allophene clays was poor throughout the year. Trafficability was periodically poor following high rainfalls on an upland soil with a perched water table and on soils from alluvium in the lowlands. Other upland soils had good trafficability throughout the year. Basic data are included as Appendix A.

Soil moisture prediction; Trafficability prediction; Tropical KEYWORDS: regions; [Hawaii]

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A U. S. Army Engineer Waterways Experiment	Ctation (WEC)	enil moi	tumo prodiction mothe
was modified to permit predictions to be man			
a site. Using this method of prediction and			
a system of mapping soil moisture contents			
these maps, soil moisture contents can be de		•	
only the field-minimum and field-maximum mo			
predictions made for 65 Costa Rica sites us: with predictions made in the United States			
method. Soil strengths, in terms of cone is			
Rica soil moisture-soil strength relation a			
simple linear regression and reduced major			
tions with the general Costa Rica relation	were compared	with meas	sured cone indexes
they fell far short of the accuracy of the	predictions u	sing the	other two prediction
techniques. Therefore, this simplified method			
method, and predictions of cone index and re linear regression relations are presented.	ating cone in	dex narug	only the simple
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S. AUTHOR(S) (Last name, lirst name, initial)				
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A PROJECT NO.	Miscellaneous	Paper 1	io. 4-362	
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11 SUPPLEMENTARY NOTES	12. SPONSORING MILI	_		
Presented at Annual Convention of	Chief of Engineers, DA			
American Society of Civil Engineers, October 1959	Hashington, D. C. 20315			
13. ABSTRACT				
This paper presents an account of the	preliminary res	earch i	nto the area of soil	
mechanics dealing with vehicle-soil re				
Research Branch of the Waterways Exper		and des	cribes the test	
procedures used and the results obtained	ea.			
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KEYWORDS: Soil-vehicle interaction; St	resses under ve	hicles;	Test procedures	
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13. ABSTRACT	<u> </u>	·			
A portion of the unsurfaced runways of Rog	ers Dry Lake.	Edwards A	ir Force Base		
California, was subjected to traffic appli	ed with a tes	t load car	t having a gross		
weight of 280,000 lb and carried on a twin	-twin gear as	sembly. T	ire inflation pressures		
ranged between 275 and 325 psi. The prima					
(a) whether the soil strength of the lake					
magnitude, and (b) the effect of load repe					
soil. It was also desired to determine th					
expected in tires inflated with air only a	nd towed over	a prescri	bed route. The		
traffic resulted in some settlement of the	soil and als	o the disp	lacement of a friable		
crust of varied thickness in some of the a	reas tested.				
KEYWORDS: Military bases; Soil strength;	Traffic tests	: Unsurfac	ed airfields:		
Unsurfaced runway performance and evaluation; [Edwards Air Force Base;					
Rogers Dry Lake]					

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S AUTHOR(S) (Last name, first name, initial)				
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this study.	Washington, D. C. 20315			
13 ABSTRACT				
This limited laboratory study was made freezing and extracting soil samples prodictive content than did mechanical so the quick-freezing was accomplished with proceinserted in the soil. In tests to well above the liquid limit, it was freeze method was almost as good as with sion was based mainly on reproducibility was used over a range of soil-moisture requires use of three types of mechanic	provided more as emplors, partic th liquid nitro on soils whose determined the th the mechanic ty of results.	ccurate cularly ogen pou moistur at accur cal samp	determination of for very wet soils. ared into a hollow re contents ranged racy with the quick- plers. This conclu- louid nitrosen probe	
KEYWORDS: Laboratory tests; Liquid ni Soil samplers	trogen; Soil moi	sture (neasuring devices;	

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This paper describes the development and validation of criteria for determining soil-strength requirements in unsurfaced soils for operation of aircraft.

KEYWORDS: Soil strength; Subgrades; Traffic tests; Unsurfaced airfields

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13. ADSTRACT				
The Flex-Trac, a multipurpose cross-co	ountry, six- and	d four-v	heel-drive vehicle,	
is articulated vertically at the wheel	.⊷base center, (enabling	the vehicle to assume	
a sway-back position (front or rear er	id higher than :	center),	an arched-back	
position (center wheels off ground),	or a "float" pos	sition (free articulation of	
all wheels). Self-propelled and towir	ig tests were mi	ade on s	oft, level terrain to	
determine performance characteristics	in terms of so	il stren	gth required for	
operation, sinkage, slippage, and draw	bar pull, and	to deter	mine cone index re-	
quirements with the vehicle in six- ar	id four-wheel di	rive in	the various positions.	
From these limited tests the vehicle a	ppears able to	operate	on soil of slightly	
lower strength than estimated from the	computed cone	index.	The principal contri-	
buting factor to the possibly better a	erformance is	the bala	nced weight distribu-	
tion on the six wheels. Excerpts from	the manufactur	er's br	ochure are included	
as Appendix A.				
KEYWORDS: Articulated vehicles; Field	tests: Mobilit	v: Track	red vehicles:	
Trafficability; [Flex-Trac V	ehicle	,,	······································	
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Conference on Shear Strength of Cohesive Soils, Univ. of Colorado, Boulder, Colo.,

Chief of Engineers, DA Washington, D. C. 20315

The paper deals primarily with the physical components of the shear strength of remolded, saturated clays and with the various factors which influence these components. The results of subsequent research by others are taken into consideration and summarized when appropriate, but the paper is not a complete review of the very extensive and important research on shear strength of saturated clays performed during the last twenty years. The sources of error in the tests performed by the writer are discussed, and emphasis is placed on clarification of the assumptions and limitations relating to the conclusions and formerly proposed criteria for the shear strength of saturated clays.

KEYWORDS: Clays; Saturated soirs; Shear strength (Soils); Soil strength

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	Washington, D. C. 20315				
13. ADSTRACT					
The Airoll represents a new concept of free-rolling, low-pressure, pneumatic	locomotion.	Its prop	pulsion system comprise		
about driving sprockets and return idl	ers. It can m	ove with	two different and		
distinct types of action of the tires	on the ground-	-rolling	-wheel track and		
stationary-wheel track actions. Self- conducted on a range of soils to deter	propelled, tow	ing, and	l towed tests were		
conditions. Results indicate that (a)	it can travel	on soft	muck and wet fine-		
grained soils negotiable by no known m	ilitary vehicle	e of ear	al weight: (b) its		
slope-climbing ability in clean sand c (c) its towing sbility on firm soil is	ompares with the	hat of t	racked vehicles;		
force required to tow it compares with	that required	for tra	cked vehicles: and		
(e) its rolling-wheel and stationary-w	heel track feat	tures ei	ve it greater travel		
efficiency on most soils than tracked suspension system; Appendix B gives th	vehicles. App	endix A	describes the Airoll		
and the second of the second o	- compared of orig	01 108	venicie come indexes.		
KEYWORDS: Airoll vehicles; Field tests soils; Trafficability	; Fine-grained	soils;	Mobility; Organic		
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12-15 June 1961.	washington,	<i>n</i> . c.	20317		
13 ABSTRACT			· · · · · · · · · · · · · · · · · · ·		
Instruments and techniques developed b					
direct measurement and remote estimati					
soils and prediction of performance of					
paper. A simple, empirical measure of					
adequately describes the trafficability	y of a fine-gr	sined so	oil and serves as the		
basis for confident prediction of mili					
or multiple passage across a level are					
or climbing slopes, and forces require	ed to tour nonse	11-prop	stred venicles.		
KEYWORDS: Fine-grained soils; Mobilit	y; State-of-the	e-art sti	udies; Trafficability;		
Trafficability prediction;	Trafficability	test in	struments		
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national Society of Terrain-Vehicle	Chief of Engineers, DA			
Systems in Turin, Italy, June 1961.	961. Washington, D. C. 20315			
13. ABSTRACT				
A study was made of pertinent soil trafficability data collected during the wet season at more than 1300 sites located principally in humid-temperate regions of the United States. The soils were identified according to the Unified Soil Classification System and U. S. Department of Agriculture textural classification system, topographic position, and two general levels of wetness. A scheme for classifying soils according to their trafficability was developed. The scheme lists the soil types in order of decreasing strength under each of four topography-general wetness level categories, and shows the probability of successful passage on each soil for vehicles with known soil strength requirements. This scheme permits the estimation of the probability of a successful operation under given soil type, topography, and general wetness level conditions. Given the choice of several routes and vehicles, the determination can be made of the vehicles with the best chances of success over a given route or which route is best for given vehicles.				
KEYWORDS: Soil strength; Statistical	distributions:	Traffica	ability classification	

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Italy, 12-15 June 1961; Published in Proceedings, Paper 32.	Washington,	o. c. 2	0315
13. ABSTRACT			
Tests to determine the behavior of sand in a special facility of the Army Hobi: periment Station. The operation of a	lity Research I	Branch o	f the Waterways Ex-
vides a continuous record of the performanging from slightly negative to 100	mance of a cir	e or tr	ack for slip values
of the same overall diameter but of dis	ferent cross-:	ection '	widths have been con-
ducted on an air-dry sand. Results sho	w that the per	formanc	e of these tires on
the first pass is dependent only upon a exert an influence on performance, the	theel load and	sinkage	. If other factors
test data show that the total traction	ir exiects are force develor	reriect	ed in sinkage. The
proximately 0.39 times the tire load.	These results	are sup	ported by an analysis
of the forces acting on the wheel. Pro	blems yet to !	e solve	d are outlined briefly
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national Conference on the Mechanics of Soil-Vehicle Systems, Turin, Italy, June 1951	Office, Ch Department	ief of Eng	ineers	
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The principal elements of landscape that affect the capability of vehicles to travel cross country are topography, surface composition and consistency, vegetative cover, and hydrography. These elements combined in various ways tend to deny and slow movement, decrease efficiency, increase maintenance, increase driver fatigue, and control direction. This paper presents a few techniques which have been developed to classify and map terrain elements in objective and fairly quantitative terms. Techniques of this type may eventually permit valid evaluations of trafficability and mobility characteristics of specific areas.				
KEYWORDS: Mobility; Terrain classification	n; Terrain f	actors; Tei	rrain mapping	

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and tidal land forms. Trafficability tive strength profiles in the various				
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of the trafficability of soft terrain : this terrain will support.				
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KEYWORDS: Muskeg; Soft soils; Soil strength; Trafficability

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Results are summarized of tests of moi:	stuva contant	deneitu	and etrangth of
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Engineer, May-June 1962, Vol.54, No.359.	Chief of En Washington,		
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This study provides a technique for por Trafficability Section, WES. The methodata (soil series and type) readily avais limited to general topography, soils Alabama and Georgia. The basic soil in trafficability classes. Vehicle mobili of passable, doubtful, and impracticable dry-season average conditions, wet-seas conditions.	ed depends primilable in public, and vegetatinformation is introduced by the Market with the m	arily or ished for on in an arterpret tank is oisture	n agricultural soils orm. The analysis or area comprising ted in terms of eight described in terms conditions including
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Agricultural Engineers, Chicago, Ill.	Washington,	D. C.	20315	
12-15 December 1961, Paper 61-609.	<u> </u>	·····		
19. ABSTRACT				
The Army's need to predict the performance of military vehicles in a wide range of soil and snow conditions has been met by the results of an empirical test program. Sciland snow conditions were quantitatively indicated in terms of the resistance offered by the soil and snow to being probed with a simple instrument, called the cone penetrometer, and vehicles were tried out on various soil and				
snow conditions. On the basis of statistical evidence, vehicle performance and come index have been correlated. The results of the Army study may possibly be applied to the solution of agricultural problems involving the interrelations of tractors and soils.				
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Annual Meeting of Highway Research Board, Washington, D. C., January 1962; published in H.R.B. Bulletin 342.	12. SPONSORING MILIT Chief of Engit Washington, D	oers,	DA .	
A basic understanding of how soft, yiel wheeled and tracked vehicles must be do conducted at the U. S. Army Engineer Waknowledge is concerned with the distributire in the medium on which it operates at the interface between the tire and twithin a yielding mass of soil. This popution of the research dealing with the tire on an unyielding surface.	eveloped. One parterways Experiention of stress. It includes the surface that paper describes	hase of ment States industry the mea support	the research being ation to acquire this according to a preumatic assumement of stresses ats it and at location obtained from that	
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Security Classification DOCUMENT CONTROL DATA - R&D Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) 1. ORIGINATING ACTIVITY (Corporate author) 20. REPORT SECURITY CLASSIFICATION U. S. Army Engineer Waterways Experiment Station Unclassified 20 GROUP Vicksburg, Miss. 3. REPORT TITLE TRAFFICABILITY TESTS WITH THE 5-TON GOER (XM520) ON FINE- AND VARSE-GRAINED SOILS 4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report S AUTHOR(5) (Las. name, first name, Initial) Rush, E. S. 6. REPORT DATE 74 TOTAL NO. OF PAGES 75 NO. OF REFS April 1962 Ba, CONTRACT OR GRANT NO. S# ORIGINATOR'S REPORT NUMBER(S) A PROJECT NO. 8570-05-001 Miscellaneous Paper No. 4-477 Trafficability and Mobility Research Subproject 8S70-05-001-02, Surface 9b. OTHER PEPORT HO(S) (Any ver numbers that may be seeighed this report) Mobility AD 646 591 10 AVAILABILITY/LIMITATION NOTICES Approved for public release: distribution unlimited. 12. SPONSORING MILITARY ACTIVITY 11. SUPPLEMENTARY NOTES Chief of Engineers, DA Washington, D. C. 20315 13 ABSTRACT Tests were conducted in soft, fine-grained soils and clean sand to determine performance characteristics of the 5-ton COER for two tire sizes. In fine-grained soils the GORR performed better with 18.00-26 tires than with 15.00-34 tires. With 18.00-26 tires it performed better than standard military 6x6 wheeled vehicles of 2-1/2- and 5-ton capacity. In sand the GOER also performed better with 18.00-25 tires than with 15.00-34 tires. In one specific clean sand its performance with either size tire was better than any wheeled vehicle tested to date by WES. Additiona' testing, particularly in snow, sand, and muskeg, is needed to evaluate the vehicle fully. The computations for determining the vehicle cone index of the COER for operation in fine-grained soils are included as Appendix A.

KEYWORDS: Field tests; Fine-grained soils; Goer vehicles; Mobility; Pneumatic tires; Sands; Trafficability; Wheeled vehicles; [Goer (XM520)]

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Rush, E. S.			
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Operation Wheeltrack was a cooperative (Ordance Tank-Automotive Command), U. S. Transportation Board and U. S. Army Transportation Board and U. S. Army Transportation of Engineers (U. S. Army Engineers (U. S. Army Engineers in Conditions. Since WES did not program and because of lack of manpower pation was only a token effort. Traffithis report were believed typical of the tion Wheeltrack. It is recommended the reported in the final report on Operation	S. Army Transponding Property of Market Park in the Cartest of the	ortation esearch ys Exper- oport ve- the deve- ield tes collect at othe be comp	Corps (U. S. Army Command), and U. S. iment Station) to hicles in varied lopment of the test t crew, WES partici- ed and reported in r areas during Opera- ared with results
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Smith, N. H.					
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During the period 1-21 February 1962, s	now trafficability te	te vere conducted at			
Camp Hale, Colorado, to determine the	erformance characteric	etics of several			
standard military tracked vehicles and	an evnerimental teet	latform (Atroll)			
operating in subarctic snow. The progr	cam included tests in a	which enous terrois			
and vehicle performance data were colle	on Included tests In the	which show, terrain,			
paper, the performance of the Airoll i	included the force of	ourposes. In this			
since the wessel has excellent performe	s compared with that (of the M290 Weasel,			
armed and accord mas executent belieful	uce cuaracteristics in	soit terrain.			
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Waterways Experiment Station, Vicksburg,	Mississippi	, 13-15 Ju	ne 1972
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This report summarizes the discussion	ons in a mee	ting held	at the U. S. Army
Engineer Waterways Experiment Station on	13-15 June	1962 of a 1	board of consultants,
representatives from the Office, Chief of Station personnel on the subject of mobi	I tngineers, lity researc	and Water h. Subjec	ways Experiment
a review of mobility studies at WES (S	J. Knight),	relation of	f MEGA and mobility
studies (J. R. Compton), single wheel te	sts in sand	(C. J. Pow	ell), single wheel
tests in clay (R. D. Wismer), soil stren configuration studies (M. E. Smith), som	gth measurem	ents (J. L	Smith), tire
Jr.), review of Bekker theory (Dr. M. J.	Hvorslev).	review of	load-flow theory
(W. G. Shockley), review of CARDE theory	(R. D. Wism	er), and W	ES concept of
mobility research (R. G. Ahlvin).			
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KEYWORDS: Airfield construction; Engineer: Military bases; Temperate region Ft. Stewart, Ga.]			

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Society of Automotive Engineering Con-	Chief of Engineers, DA Washington, D. C. 20315		
gress and Exposition, Detroit, Michigan, January 1963, Paper 623E,			
13. ABSTRACT			
In a test program jointly supported by Engineer Waterways Experiment Station			
the ability of wheeled military vehicl	es to climb slo	nes of	loose sand. Tests
were conducted on a variety of beach a	nd dune sands.	Test p	rocedures and tech-
niques are described briefly. The str	ength of the sa	nd on t	he slopes was
measured by means of a cone penetromet			
each of the five sizes of vehicles tes by the strength of the sand and by tir	ted is snown to e size and infl	ation n	ermined principally bressure. An empirica
method employing firm-surface tire-pri	nt data, wheel	load, a	nd sand strength is
presented as a means of predicting the	sand slope-cli	imbing c	apability of conven-
tional all-wheel-drive vehicles.			
KEYWORDS: Coarse-grained soils; Field tests; Military vehicles; Slope			
performance; Trafficability;	Mudeered Aeurol	.es	
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Proceed. of Second Symposium on Remote	U. S. Army II	ateriel	Command
Sensing of Environment, University of	Washington,		
Michigan, October 1962.			
13- ABSTRACT			
This paper discusses the surveyly sime		- e Al -	
This paper discusses the overall aims	and onjectives	or the	waterways Experiment
Station program in terrain interrogation	ion using senso	rs opera	iting in certain
portions of the electromagnetic spects	rum, describes	the infi	rared equipment and
tests conducted, and analyzes results	obtained.		
KEYWORDS: Infrared detectors; Infrared	d rays; Laborat	ory test	a: Remote sensing:
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Rush, E. S. Garrett, E. E.			
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13. ABSTRACT			
Operation Swamp Fox II (U. S. Army Tra the third of a series of environmental Board in the Republic of Panama, and w tific-engineering research of environm camp and conducting tests under contro ability data was made available to th Station observers by the mobility test to the period 29 September-15 October The other data and information reporte authors. This memorandum was prepared	operations con as designed to cont-vehicle relied condition of U.S. Army E team because 1962. The analysis were collect.	nducted provide lation be. Most ngineer WES part lysis waed, at 1	by the Transportation more complete scien- y establishing a base of the basic traffic- Waterways Experiment icipation was limited as made by the authors.

KEYWORDS: Field tests; Military vehicles; Mobility; Trafficability; Tropical regions; [Panama; Swamp Fox]; Town analysis

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This paper describes the study of the effects of terrain on military activities; most of the effort so far has been concentrated on a study of the environment as it affects vehicular mobility. The families of the factors thus far dealt with are surface geometry, surface composition, hydrologic geometry, and vegetation. The surface geometry family is concerned only with the physical shape of the surface of the earth and is subdivided into the gross surface geometry (macrogeometry) and the minor surface irregularities (microgeometry). An arbitrary relief of 10 ft has been selected as the dividing criterion. The surface composition family is concerned with the physical characteristics of the materials of which the surface is composed. The shape, size, and distribution of vater bodies of all kinds are characteristics described by the hydrologic geometry family. The vegetation factor family is concerned only with the geometry of the vegetation structure as a whole and not with the taxonomy of the individual plants. On the basis of tests, it was determined that (a) surface microgeometry exhibits the greatest effect on vehicular movement, and (b) critical tree spacing appears to be more closely related to vehicle length and not to turning radius.

KEYWORDS: Mobility; Terrain analysis; Terrain classification; Terrain factors

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This is a report of the first of many trips made to rice fields in Stuttgart and Kelso, Ark., and Crowley, La., in a study to determine seasonal characteristics of the rice fields pertinent to military operations. Soil, terrain geometry, vegetation, and hydrologic geometry data collected during the peak of the wet season are reported and discussed.

KEYWORDS: Mobility; Rice fields; Terrain factors; Trafficability data; [Arkansas; Louisiana]

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need have failed to apply basic scient	iric methods a	nd princ	iples in a consistent
manner. Some of the shortcomings evid	ent in modilit	y resear	ch methods are pointed
out. New knowledge obtained from mobil	lity-oriented	studies	now in progress at the
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A new concept in soil mechanics is sou	ght which will	cope wi	tn the problem of the
behavior of soil when massive displace	ments are invol	lved, as	occurs when a wheel
cuts a deep rut in soft material. It is suggested that such movement of soil is			
more in the nature of a flow phenomenon, and an energy-per-unit-volume concept is			
hypothesized. The load-sinkage curve	is assumed to l	e of th	e general form
$y = ax^n$; this assumption may have to	yield in time t	to some	other more accurate
representation, possibly a hyperbolic	function. Exp	ressions	have been derived for
predicting sinkage and towing resisting			
of plate penetration tests. These exp			
cover more complicated performance of			
of the theory in dry descrt sand (as f	ound near Yuma	, Ariz.)	is presented.
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The U.S. Army Engineer Waterways Experiment Station at Vicksburg, Mississippi, is conducting systematic studies that will provide information on factors which				
influence vehicle mobility in deformab				
studies is to develop rational means o				
provide specified levels of performance				
stresses at the interface of a moving	pneumatic tire	and the	medium upon which it	
travels is one such study. This paper				
measure the distribution of stresses a				
presentative test conditions. Two soi				
a test pit, were used in the program.				
levels of strength. Only one tire at				
were neasured at several different inf	lation pressure	es. Tes	ts were conducted with	
the wheel powered and with it towed.				
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13 ABSTRACT	<u> </u>	
The Terrain Analyzer Project of the Wa exploiting the electromagnetic spectru those elements of the terrain that hav paper describes the project, which is red, radar, and gamma-ray studies are	nm as a means of we an effect on in its first,	of identifying and quantifying n military operations. This
KŁYWORDS: Gamma rays; Infrared rays,		sts; Kadar ; Kemote
sensing; Soils; Tratficabil	ity	
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Knight, S. J.				
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Published in Journal of Terramechanics	U. S. Army Na	ateriel	Command	
vol 1, No. 1, 1964.	Washington, I	o. c. 2	0315	
13 ABSTRACT	· 			
An engineering irvestigation and devel means for predicting field performance for use in improving their mobility ch U. S. Army Engineer Waterways Experime a very brief résumé of the terrain-veh Experiment Station.	of military venaracteristics land station since	chicles nas been ce 1945.	and furnishing data in progress at the This paper presents	
KEYWORDS: Military vehicles; Mobility	; Stare-of-the-	art stud	ies; Traff. ability	
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Knight, S. J. Boyd, C. W.				
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Published in The Military Engineer, Vol. 56, No. 372, July-August 1964.	U. S. Army Washington	Materie!	l Command	
3 ABSTRACT	!	·	·····	
An essential feature of military plans various soils, i.e. the ability of the military vehicles. In this article, to or trafficability of sands is describe SW under the Unified Soil Classificati condition. Such sands are characteris of beaches of continental island shore action. The sands discussed do not in the behavior of these sands under vehithat of dry-to-moist sands.	soils to sup the variation d. The sands on System, and tic of inland is not actually actude those in	port the that occurrence discussed are in deserts y undergon very we	pashage of various ars in the strength ed classify as SP or a "dry-to-moist" and of the portions bing wetting by wave et condition, since	
KEYWORDS: Coarse-grained soils; Sends	; Soil strengt	h; Traff	ica>ility	

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ing Group on Ground Pobility, London,	Washington, D	. C. 20	315
England, 24 June-2 July 1963.	<u> </u>		
13 ABSTRACT			
Each time a new vehicle is proposed, t	he shoice of run	ning gea	er can be made only
after careful consideration of many fa-	ctors, the most	influer	ial one dictating
the use of tracks over wheels being so	ft-soil perform	ance. A	est wheeled vehicles
used at the present time have less mob	ility than trac	kad vali	clar of the same
weight. If the mobility of cither type	arrey chan erac	C 40 P	improved desire
having control processes as less as and	this was be de	s to be	improved, designs
having contact pressure as lew as poss	ible mast be ce	serobea.	It was determined
that this can be achieved for wheeled	Acurcles by Tuc	reasing	the number of wheels
or by increasing the size of the tires	, or by a combi	nation t	thereof, but that it
is more effective to increase the tire	size. It was	further	determined that while
light vehicles could be equipped with	available vires	that wo	ould make them con-
petitive with tracks on soft ground, t	he tracked vehi	cles hav	e higher pull/weight
ratios on firm soil. This paper utili	zes the data. t	echnique	s. resources. and
experience of the Land Locomotion Labor	ratory U. S. A	rmy Tank	-Automotive Cornand
and of the Army Mobility Research Brand	ch. Mobility an	d Enviro	onmental Division
Waterways Experiment Station. Technique	ing of these or	canizati	one are described :-
Appendixes B and A, respectively.	- Circuc Of	6-11-6-6-6-1	ions are described in
KEYWORDS: Mobility; Soft soils; Soil-t	rack interaction	n; Soil-	-wheel onteraction;
Snow; State-of-the-art studi	es		-
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of the Terrain Sub-Group of the Tripartite	12. SPONSORING N	ILITARY ACTI	VITY
Working Group on Ground Mobility, Oxford,	U. S. Army	Materiel	Command
England, 24 June 1963	Washington		
13. ABSTRACT	l	 	-
The results of vehicle tests have sho	wn that quan	titative d	escriptive and
classification systems constitute the most			
for mobility purposes and that once such sy			
be conducted in known environments which ca	n be extende	d with nea	rly complete
confidence to other areas of the world which	h exhibit th	e same num	erical parameters
upon analysis. Existing traditional litera	ture on land	forms can	be associated with
quantitative descriptive systems and stored mobility prediction systems. Three basic p	on computer	systems i	or later use in
ways Experiment Station in the field of mob	lugiams ale ilitu recesr	cp. (a) t	he development of
detailed quantitative systems for describin	g and classi	fving envi	ronments. (b) the
testing of the responses of vehicles to kno	wn environme	nts, class	ified both quantita-
tively and traditionally, and (c) the corre	lation of tr	aditional	classifications with
quantitative classifications.			
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KEYWORDS: Mobility; Terrain analysis; Terra	ain classific	ation; Ter	rain factors

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papers, the Committee's conclusion	iscussions and ques ns and recommendation	ons relat	report of an Ad Hoc	
Working Group recommended by the (Committee to examin	the appli	cability of an	
airborne profilometer to obtain to	errain profiles. T	ne papers i	ncluded reports on	
WES studies related to Project MEI	RS, review of project	t history,	conclusions and	
recommendations of the first acvis	sory Committee meet:	ing held at	Bethesda, Maryland,	
on 7-9 November 1962, accomplishme meeting, Marah Screw Amphibian tes	ents on Project MEX	tasks sin	ce the lirst committee	
next 12 months, and funding status	s and requirements	for fiscal	vear 1965.	
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KEYWORDS: Meetings; Mobility; Sta	te-of-the-art studi	es; Praffic	ability	
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ping, Kansas City, Mo., 24-26 Sep 1964	wasningto	m, o. c.		
13. ABSTRACT				

The distribution of things in any approximately homogeneous population can be adequately described by a sample which is coincident with a minimal area called the "structural cell." The smallest area which can be depicted on any map is a function of the map scale and is called a "mapping cell." Areas of lesser extent than the mapping cell cannot be shown and are therefore merged into the map unit of greater occupance, resulting in a map unit characterized in the legend as a single population, but in fact representing areas composed of two or more populations. Such a map unit has a "reliab'.lity" of substantially less than 100 percent. Retention of detail with scale reduction depends upon recognition of the scalar relationships between the mapping cell and the structural cells of the populations being mapped. The boundaries between the units are generalized according to a set of prescribed rules, and a legend is designed consisting of diagrammatic representations of "unit areas" in which the relative proportions, as well as the schematic positional relations of all populations comprising the generalized map unit are identified.

KEYWORDS: Terrain analysis; Terrain mapping

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12. ABSTRACT			
During the period 21-25 September 1964 in a quantitative way the various cleme to devise an approach toward its solut. The participants in the exercise are 1 conference outline is included as Appeled concepts, two wheeled (5x8 and 10x10) of existing empirical and quasi-theores occurrence of soil conditions. A plan test the validity of the design technic model for future exercises in mobility was directed toward the soft-soil asper plan incorporating tests of other envisis included as Appendix E; a study of included as Appendix F.	ents of the surion. The problisted in Appendix C. During and one tracked tical knowledge of tests was dues employed, . In each phasect of the mobil ronnental factor	face no em is d lixes B the ex l were and in lesigned but als c of the ity propers also	bility problem and iscussed in Appendix A and D and the pre- ercise, three vehicle designed on the basis the light of worldwide that not only will o will serve as a e analysis, emphasis blem. However, a was suggested and
KEYWORDS: Meetings; Mobility; Vehicle	design;[Mcn'lit	y Exerc	ise A]

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Michigan, 9-10 February 1965	Washington,		Commend	
13 ABSTRAC1	·			
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Two general categories of snow were cor				
cap snow end the "temporary" (subarctic United States. Test results indicated				the
vehicles could travel over the level, r	permanently cov	ered. de	ep snow areas of the	ne
Greenland ice cap and over the subarcti				
deep. Maximum drawbar pulls on ice-car				
from about 35 to 45 percent of the gros				tic
snow, maximum drawbar pulls depended si	ignificantly up	on the c	lepth of the snow.	
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KEYWORDS: Arctic regions; Field tests;				
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s AUTHOR(5) (Lest name, first name, initial) Woods, Harry K. Shamburger, John H.				
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Army Materiel Command			Projects Agency	
Washington, D. C.	lashington, I). C.		
One of the tasks in connection we bility to predict in quantitative term country performance of ground vehicles in the U.S." This report is co. erne selection and preliminary description	s the effects o vas entitled " d with the firs of test areas s	f terra Proof T t phase elected	ain obstacles on cross- lests of Ground Mobilit of the proof tests,	

KEYWORDS: Military bases; Temperate regions; Terrain analysis; Terrain factors; Terrain mapping

multiple-factor tests. Camp Lejeune, N. C., Carr A. P. Hill, Va., and Eglin AFD, Fla., offer more areas suitable for conducting single-factor tests than the other reservations. A variety of combinations of slopes and stem spacing desirable for conducting multiple-factor tests is present at Camp A. P. Hill, Va., Camp Pickett,

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TESTS TO EVALUATE THE MOBILITY OF JICKE	AND FISHER V	EHICLES		
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13. ABSTRACY	l		· · · · · · · · · · · · · · · · · · ·	
The tests reported herein were conducted formance of the Jiger and Fisher vehicl conducted by personnel of the Organic McMaster University, Hamilton, Ontario, Wespons Research, Defence Research Boar Laboratory were invited to send observed	les in muskeg t and Associated under contrac d, Canada. WE	errein. Terrain t to the	The tests were as Research Unit of Directorate of	
KEYWORDS: Field tests; Light utility w [Fisher vehicle; Jiger vehicl	rehicles; Mobil: e; Parry Sound	lty; Mus . Ontari	keg; Trafficability;	
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An investigation was conducted usi			
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and a single plate-bearing test us			
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to yield a mean value which could	be expected to be w	sithin 6 pe	ercent of the true mean
value.			
KEYWORDS: Cone penetration tests;	Laboratory tests;	Penetratio	on resistance (Soils);
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Tire deflection data were studied from tests performed in the single-wheel test facilities at the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. The tests were performed with a smooth 11.00-20, 12-PR tubular tire moving under a 3000-1b load in mortar sand of various strengths and a smooth 9.00-14,2-PR tubuless tire moving under an 890-1b load in Yuma sand of various strengths. Plots are presented of the path of a point on the center line of the tires relative to a moving and a fixed frame of reference. Representative plots are included to show the effect of slip, soil strength, and inflation pressure on the path and to compare the paths of a point on towed and powered tires.

CEYWORDS: Laboratory tests; Pneumatic tires; Sands; Tire deflection

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13 ABSTRACT	·		
A program of field tests was conducted its performance on a range of soil cond of ability to travel 50 passes in the shar pull, and slope-climbing ability. Soil type, moisture content, density, a performance and soil condition are presented.	ditions. Perfo same path, mane Soil conditions and come index.	ormance i averabi e vere d	was expressed in terms lity, speed, draw- lescribed in terms of

KEYWORDS: Buoyant screw vehicles; Field tests; Fine grained soils; Mobility; Trafficability

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A method is presented for studying the results of tests with whoels in soils. The first part of the paper emphasizes the need for a framework to describe observed facts, and in the next part of a method is developed to provide this framework. The method considers the work of the pull developed by the test wheel as the difference between energy input and energy dissipation. The parameters used to represent these energies are explained relative to the theoretical case of a rigid wheel on a hard surface. This reference condition also is used to distinguish the particular features of rolling motion on deformable soils.

KEYWORDS: Soft soils; Soil-wheel interaction; Trafficability; Wheels

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13 ABSTRACT			
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Tests were conducted at three differen			
and at three different payloads. A to 28 May 1965 near Vicksburg, Miss. Su			
Proving Ground, Md., from 21 to 24 Jun	ne 1965. The A	berdeen	Proving Ground tests
are discussed briefly in Appendix A.			
It was concluded that (a) the Ch			
most soft soil conditions, (b) a rel			
gear assembly into a soil and the rat (c) the presently designed cargo ramp			
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13. ABSTRACT

A conference of the Board of Consultants on Remote Terrain Analyzis by Electromagnetic Means was held at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, on 18-19 November 1965. Only summaries of the technical papers presented are given herein; complete texts of these presentations of text programs and results to date will be published as WES technical reports under the general title Terrain Analysis by Electromagnetic Means. Exhibit 1 is the program for the meeting, and Exhibit 2 is a list of attendants. Exhibit 3 describes proposed future plans. Exhibit 4 presents the report prepared by the Board of Consultants at the conclusion of the conference.

Washington, D. C. 20315

EFYWORDS: Electromagnetic radiation; Meetings; Remote sensing; Soils; State-of-the-art studies; Terrain analysis; Trafficability

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13 ABSTRACT		
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techniques are needed to allow direct :	mensurement of electr	col properties of the
spils. These properties then can be co	orrelated with the th	ickness of the upper
layer and the moisture content of the	soil.	
Resides soil layers, such factor	e as suil conductivi	ty and vesetation
determine the usable wavelength region.	The effects of one	in of those are discussed
and examples of several soil-levering p	marilar that might b	n of these are discussed
terrain are given. The limits to which		
the return energy are illustrated. The	se limits are determ	ined by the thicknesses
of the layers and the electrical proper	ties of the soil com	prising each layer.
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13 ABSTRACT			
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Gamma radiation from soil samples wis measured, and the results were analyzed to evaluate the use of gamma rays in remotely determining soil parameters useful in estimating trafficability. Gamma-ray spectra were obtained from representative samples of sand, silt, and clay placed in a low-tackground inclosure. Photopeak counting rates and photopeak ratios of therium, avanium, potassium were considered in the analysis. Fesults indicated that photopeak counts of the radio-isotopes of primary interest were proportional to moisture content of the soil simples, but ratios of the photopeaks were nearly independent of moisture content, alth. gh different for each soil tested.

Gamma-ray measurements were also made on soil samples obtained from all 50 states in an attempt to correlate the ratios of their photoreaks of thorium, uranium, and potassium with soil type and other morphological, genetic, and physical-chemical characteristics of the soils.

KEYWORDS: Gamma rays; Laboratory tests; Remote sensing; Soils, rafficability

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13 ABSTRACT	i		
The dimensional analysis and the empir dimensionally correct formula for appra rigid or a pneumatic-tired wheel are chord concept, for handling the geomet configuration of a pneumatic tire in s is presented. The formula that is deviange of tire sizes, wheel loads, and type, namely cohesionless dry Yuma designot clay. The developed formula is P _T = 0.85 W(z vertical load, z is sinkage, and I line of tire contact area in the direct	oximating the to presented. A ry of the comple off soil (based eloped sat. fied tire deflections ert sand and high	owing remethod, ex pheno on expend quite s in two phly plus P _T is	cosistance for either called the moving omenon relating to the crimental evidence) effectively a wide o extremes of soil astic Louisiana bucktowing force, W is
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marine interfaces with regard to grou			
herein. The description involves the			
zones of the interface, and the measu			
properties of those zones. The range property is divided into suitable cla	or Astres of	esignat	ion exhibited by each
number. A total of 27 coastal sites	sies, and each in northwest ar	CISSS 1	s assigned a code
the Florida Keys and 14 coastal sites	in Theilend er	n west ne evalu	sted according to the
newly developed system. A comparison			
based on relative frequencies of occu			
property is presented, and areas that			
similarity are identified. General c			
on the Gulf of Sism have characterist	ics that ere of	losely s	pproximated on the
northwest and west central coasts of	Florida. (b) th	e land-	marine interfaces on
these shores exhibit a close analogy	when compared :	ith reg	erd to structural
zones, and (c) land-marine interfaces	of the two are	es not	within a gulf
environment (i.e. those not protected	from oceanic v	tte sve	sck) exhibit divergent
characteristics.			
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KEYWORDS: Beach trafficability; Coas analogs; Terrain factors;			

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Horizontal and vertical forces, torque, slip, and sirkage were measured. The test tire. The soil strength was varied over the full practicable range. A dimensional terms: the shape number $\frac{b}{d}$, the deflection number $\frac{\delta}{b}$, and the clay loading

number $\frac{\text{Cd}^2}{W}$. Four dependent Pi terms—the pull number $\frac{P}{W}$, the sink ge number

 $\frac{z}{d}$, the torque number $\frac{Q}{dV}$, and the towed force number $\frac{r_T}{W}$ -- were used as measures of tire performance. The experimental results showed that the consistency of the soil could be evaluated, and that true scaled systems could be achieved. A single term was developed that combined all of the independent parameters and this term was shown to be related to the dependent parameters. Curves delineating the following relations were developed:

$$\frac{P}{U}$$
, $\frac{z}{C}$, $\frac{Q}{CU}$, $\frac{P_T}{U} = f \left[\frac{Cdb}{V} \left(\frac{\delta}{h} \right)^{1/2} \right]$

KEYWORDS: Clays; Dimensional analysis; Laboratory tests; Mobility numbers; Pneumatic tires; Soil-wheel interaction

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3 REPORT TITLE				
VARIATION IN TRAFFICABILITY OF FOUR LO	ess soils			
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S AUTHOR(5) (Lost name, first name, initial) Bassett, John R. McDaniel, Alvin R. [Knight, Sterling J.				
6 REPORT DATE August 1966	7. TOTAL NO OF	PAGES	75 NO OF REFS	
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Published in SSSA Proceedings, Vol 31,	U. S. Army	Materie	ol Command	
No. 1, Jan-Feb 1967, titled "Trafficabil	Washington			
ity of Four Loess Soils."				
13 ABSTRACT				
Grain-size distribution, Atterberg lim weight, field moisture content, and st were measured once during the wet seas Louisiana and southeast Arkansas. Soi series: Loring, Granada, Callowry, an soil profiles of the soil series are g was used to relate cone index, renolditively, to mok ture content for all se between individual series regressions group equation for rating cone index w 66 percent of the variation in rating mok ture content. To illustrate use c rating cone index was used to estimate	rength of the on at 65 test ls were model at Henry. Scrigiven in Appending index, and eries, individuate vere not significant come index assof the results,	6- to 12 sites los silt los es descr ix A. I rating o ally and ficant (0.01) ociated the gro	e-in. soil layer ceated in northeast ans of four related riptions and typical Regression analysis core index, respec- i grouped. Differences (0.05 level). The level) and explained with changes in oup equation for	

KEYWORDS: Field tests; Loess; Soil property relations; Soil property variations; Trafficability; [Arkansas; Louisiana]

a TD-9 tractor for each day of a 16-month period. The estimates agreed closely with observed field conditions, suggesting that the four series can be combined

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for trafficability classification.

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report. 5. AUTHORIS. (First rome, middle initial, lest name)						
Rula, Adam A. Freitag, Dean R. Knight, Sterling J:						
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Engineers, Inc., Detroit, Michigan,		ny rateriel				
5-13 January 1967; Paper No. 670171	Washington, D. C. 20315					
13. ABSTRACT	L					
A group of specialists was assembled at the U. S. Army Engineer Waterways Experiment Station (WES) to consider quantitatively the various elements of the entire vehicle mobility problem and to suggest an approach for achieving a substantial degree of solution. One specific purpose of the meeting, and the one that is the subject of this paper, was to design a number of vehicles capable of operating in remote areas of the world where extremely soft soil conditions predominate.						
Methods of design based on research studies at the WES and at the Land Locomotion Laboratory, U. S. Army Tank-Automotive Center, were employed to specify tractive component characteristics that would yield the desired soft soil performance. The final concepts that were evolved reflect chiefly the soft soil requirements, but other factors such as obstacle performance were also kept in mind. This paper describes the application of the design methods and presents the two wheeled-vehicle concepts and the one tracked-vehicle concept, that were evolved to satisfy the basic assumptions.						
KEYWORDS: Meetings; Mobility; Vehicle des						
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I	U. S. Army Arctic Test Center		
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13. ABSTRACT	<u> </u>		
A method for classifying and mapping	terrain featur	es pertinent to off-road	
mobility in selected temperate, tropic	cal, and deser	t areas was applied to	
subarctic terrair in this study. The	area involved	borders the Automotive	
Test Course of the U. S. Army Arctic	Test Center at	Fort Greely, Alaska, and	
is roughly 2000 ft wide and 15 miles	long. Conditi	ons mapped were those	
prevalent during the late summer. The	e classificati	on and mapping method proved	
satisfactory with only minor modificat	tions. Terrai	n factors unique to cold	
regions which require additional reser	arch before th	ey can be properly classified	
and mapped for mobility test purposes		of thaw, snow depth, snow	
type, ice thickness, and stream turbic	aity.		
KEYWORDS: Military bases; Offroa	d mobility:	Subarctic regions:	
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mapping; [Fort Greely,	Alaskal		
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KEYWORKS: Mathematical analysis; Performance predictions, Pneumatic tires; Soit soils; Soil-wheel interaction; Tire performance

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Paper published in Journal of Terra- mechanics, vol 4, No. I (1907), pp 31- 48.	U. S. Army Washington,		
13 ABSTRACT	<u> </u>		
Trafficability tests were conducted in 9- to 10-ton wheel loads, the LeTourned LeTourneau Log Stacker, Model F. Forthree different soils classified CH, Cominimum soil strength requirements (verification of the original mobility index formula, discussed in the original mobility index formula for two vehicles. When the Digger's tire to 27 psi, the experimental VCI was regest that the development of traffication of a vehicle will require a careful and soil by vehicle wheels or tracks and clayers.	cau Electric Di cy-one "go-no g CH/CL, and CL/M chicle cone ind cre 185 and 150 Appendix A, pro or computing ve inflation preseduced from 185 cility criteria nalysis of the	gger, Mo o" test: L. Ress exes) for ; respectived to hicle consume wa to 160 for le- rate of	odel 1-28, and the swere performed on ults showed that the or 50 passes of the ctively. A revised be more reliable than one indexes of the sreduced from 75. Limited data sugses than 10 passes remolding of the
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of studies related to soil trafficability prediction conducted since the last consultants meeting in 1958 and to afford the consultants an opportunity to comment on problem areas and make recommendations for future research. Summaries were presented on atudies as follows: methods of soil moisture prediction for trafficability purposes (C. A. Carlson); effects and deficiencies of factors used in WES soil moisture prediction system (A. R. McDanial); a tentative soil strength prediction system; influence of water tables on soil moisture and soil strength (J. G. Collins); influence of soil variability on soil moisture and soil strength predictions (H. D. Molthan); comparison of soil moisture prediction factors for temperate and tropical climates (M. H. Smith); predicting and portraying soil moisture on an areal basis in Costa Rica (A. R. McDanial); and soil trafficability classification scheme (M. P. Meyer).

KEYWORDS: Meetings; Soil moisture prediction; Soil strength prediction; Stateof-the-art studies; Trafficability; Trafficability prediction

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Meeting of the Quadripartite Standing Work- ing Group on Ground Mobility, Kingston and Parry Sound, Ontario, Canada, 9-19 Aug 1965	U. S. Army		Command & the Advanced	
Parry Sound, Ontario, Canada, 9-19 Aug 1965	Research P		ency, Directorate of	
19. ABSTRACT	Kemote Are	a Conflict		
This report summarizes two WES contra	ct studies i	n vehicle	ride dynamics. each	
with a different approach to the problem of				
response characteristics. One study, condu-	cted by Chry	sler Corpo	ration, is reported	
in "A Study of the Vehicle Ride Dynamics As	pects of Gro	und Mobili	ty," WES Contract	
Report No. 3-114, Vols. 1 and 2, Mar 1965 a	nd Vols. 3 a	nd 4, Apr	1965. The other,	
conducted by FMC Corporation, is reported in	n "A Compute	r Analysis	of Vehicle Dynamics	
While Traversing Hard Surface Terrain Profi 1966. The dual approach reveals two separa				
to define force and motion in a suspension				
can be used to improve the design of suspen				
mathematical model appears to do. The othe	r problem is	to descri	be motion in objective	
terms in such a way that the mathematically	derived ter	ms correla	te directly with	
human response. While a satisfactory solut				
achieved, it appears that the Chrysler Corporation statistical procedure will be suitable for this purpose.				
earcante for cuts purpose.				
KENWORDS: Computerized models; Mathematical	l models; Mo	bility; Rid	le lynamics,	
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Vol 59, No. 390, Jul-Aug 1967.			, Mississippi
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IB. AGSTRACT			
The aerial cone penetrometer is a	simple device	for the d	etermination of soil
trafficability for a remote source. It	has a number	of possib	le military applica-
tions and would require only a modest a			
a practical Army tool. The credibility			
exemplified by the smooth and reproduci			
(as measured in terms of cone index) an		netration (of the aurial pene-
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U. S. Army Materiel Command Washington, D. C.

15. ABSTRACT

Trafficability tests (12 self-propelled and 4 maximum drawbar pull) were conducted in a heavy clay soil to determine performance capabilities of a small, two-wheel-drive industrial tractor. The minimum soil strength required for 50 passes of the vehicle, or the vehicle cone index (VCI), was determined from these tests to be 49. The VCI computed by a revised (March 1967) mobility index formula was 51. The one-pass VCI determined from the self-propelled and limited maximum-drawbar-pull tests was 27, or 55 percent of the experimental 50-pass VCI.

KEYWORDS: Clays; Field tests; Fine grained soils; Mubility; Tractors; Trafficability; Vehicle cone index; Wheeled vehicles

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A procedure is presented for the areas (RTA's) in which the Quadripartite n vehicles. The procedure consists of four a. Selection of areas of national interest. c. Selection of PTA's within each maximum number of facet type defector of all RTA's in term composition, factor value ranges factor values mapped independent the factor value descriptions must be in the which significantly affect vehicle perform a. Soil factors: soil mass strengt b. Vertical obstacles: macroslope, approach angle, soil mass strengt c. Lateral obstacles: spacing, sted. Longitudinal obstacles: spacing clustering, soil mass strength. e. Water-land interface: depth, ap	ations can to phases: nterest by end for the facets member nation is as found in as of landscan is characterizely. members of ranguance. The form the soil surfaction is step height, th. mem spread, by the spread is the spread is surfaction in the spread is spread in the spread in t	ach of the comprising in a local rathe area pe pattern ing each for each streng width, less anching he ter, bendir, current in the comprision of the compression of t	Quadripartite nations g the areas of tion which exhibits s of national interest, facet and subfacet acet and subfacet, and es for those factors hypothesized to be: th. ngth, spacing, ight, clustering indexing strength, velocity.	
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This paper presents limited background on ground-flotation criteria development and some of the concepts on which current criteria are based. It gives an insight into various problem areas in development of the criteria and explains the extent or limits of applicability of flotation criteria presently in use. In the final portion of the paper, emphasis is given to the particular aircraft characteristics that contribute good or high flotation and some discussion is presented of factors, not treated by current criteria, which recent research indicates may have a significant effect on flotation.					
KEYWORDS: Aircraft; Ground flotation					

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13. ABSTRACT	٠		
This study was directed toward obtain			
soil system from a qualitative investigati			
ing in soft soils, using failure theories	of classical	l soil mech	nanics. A series of
powered-wheel, programmed-slip performance	tests condi	ucted in sa	ind and clay were
analyzed.			
The soil in contact with the tire is	considered t	to be in a	state of failure at
all slips, and it is hypothesized that the	characteri	stic shape	of the pull-slip curve
is not due to the increase in soil deforma	tion, but to	the rotat	ion of the failure
plane with respect to the tire-soil interf	ace. Using	some simpl	le assumptions and the
approximation that measured forces were un			
tact surface, it is demonstrated that the	hypothesis :	is a plausi	ible one. A key ele-
ment in the analysis is the determination	of an angle	9 that r	represents the angle of

A discussion of slip is included as Appendix A.

and a hyperbolic relation in clay.

KEYWORDS: Laboratory tests; Pneumatic tires; Soft soils; Soil-wheel interaction; Trafficability

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the tire contact surface relative to the horizontal. Using this angle and the forces measured in a test, a relation between the ratio of tangential and normal stresses and slip was developed. This relation is interpreted as a measure of the rotation of the failure plane. There appears to be a linear relation between θ and slip in sand,

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KEYWORDS: Fine-grained soils; Soil strength; Walking speed

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Detroit, Mich., 12-15 Dec 67 (No. 67-619)			
13. ASSTRACT			
Analysis techniques developed at the U. S. Army Engineer Waterways			
Experiment Station for military trafficability studies are described.			
Similarities between operations of military vehicles and forestry vehicles			
are noted, and the results of tests conducted with a rubber-tired skidder			
are presented and analyzed.			
POWEDDDG. Parantum making an Militarum making an managan kanakan Kajal danda M.L.I.d.			
KEYWORDS: Forestry vehicles; Military vehicles; Trafficability; Field tests; Mobility			
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Penetrometers are well suited for measuring soil properties, but there are some factors that limit their applicability. Test data accumulated by the U.S. Army Engineer Waterways Experiment Station are used to identify these factors and to indicate their influence.

KEYWORDS: Penetrometers; Soil penetration tests; Soil property measurements

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(8-10 February 1967, Vicksburg, Mississipp	i)			
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13. ABSTRACT			· · · · · · · · · · · · · · · · · · ·	
A second meeting of a group of mobility, se	oil, and ter	rain evalu	ation specialists of	
the U. S. Army Materiel Command and the U.				
associated consultants, was held at the Wa				
1967 to design and implement an agreed-upon	n field prog	ram for te	sting the three	
vehicle test beds.				
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GAMMA-RAY MEASUREMENTS TO EVALUATE SOIL PRO	OPERTIES .			
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13. ABSTRACT				
Gamma radiation from soil samples obt Puerto Rico was measured in the laboratory the use of gamma-ray measurements to conve	and the res	sults were	analyzed to evaluate about the soil. The	
d ta were arranged according to land usage classifications according to the following geological material age, U. S. Department and USDA Soil Order based on the Seventh A	systems: of Agricult pproximation	geological ure (USDA) n. By plot	material type, Great Soil Group, ting the gamma-ray	
photopeak count ratios of Th ²³² /K ⁴⁰ vers	,		normalized photopeak	
counts for U ²³⁸ and Th ²³² versus sand content, it was shown that the criteria for separating the soils were either too broad or not significant to the gamma-ray emissive characteristics of soil. However, the data showed that the Th ²³² and U ²³⁸				
photopeak counts depended upon the particl cated that gamma-ray measurements can prov	e size dist ide a qual .	ribution in tative indi	n the soil and indi- loation of sand content	
KEYWORDS: Gamma rays; Laboratory tests; R	emote sensi	ng; Soils		

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the conditions tested, wheel performance was found to be independent of testing techniques with one exception: Consistent differences were noted when comparing results of programmed-increasing and programmed-decreasing slip tests. Although this disagreement occurred only for a narrow range of slip (approximately -10 to +10 percent), it can be important.

A brief analysis of the hurizontal forces acting on the dynamometer is given to amplify certain relations, particularly differences in pull-slip and drawbar pullslip responses. It is shown that because of the inability to always attain a stable condition, controlled-slip tests are better than controlled-pull tests for defining pull-slip and torque-slip relations.

KEYWORDS: Laboratory tests; Pneumatic tires; Sands; Soil-wheel interaction; Test techniques; Tire persormance

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Presented at 2d International Conference on the Mechanics of Soil-Vehicle Systems

U. S. Army Materiel Command

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Washington, D. C.

of ISTVS, Quebec, Canada, 29 Aug-2 Sep 66.

Some typical aspects of the rolling motica of pneumatic-tired wheels in dry sand are described in qualitative terms. The positive slip range, between the self-propelled condition and 100 percent slip, is considered. In this range, three phases of the phenomenor are distinguished according to the rate of variation of torque and pull. The parameters used for the description are energy coefficients: torque, pull, and dissipated energy coefficients. Experimental results are given to illustrate this approach.

The first part of the paper describes the three phases of rolling motion with respect to slip and defines the energy parameters. The second part is a discussion of the observed effects of wheel load, sand strength, and tire characteristics upon (a) the rate of increase of torque at low slips, (b) the value of the maximum pull/load ratio, and (c) the rates of increase or torque energy and dissipated energy at medium and high slips.

This discussion illustrates the physical understanding of rolling motion in sand that can be gained from the comparative study of each phase for various tires under various load and soil conditions. Such a comparison provides a means of specifying the differences in performance between differentatives. The discussion also questions the agreement between observed facts and existing theories. It is found that important aspects consistently observed in tire performance are not predicted by any present theory.

KEYWORDS: Laboratory tests; Pneumatic tires; Sands; Soil-wheel interaction; Tire performance

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The major/minor wheel vehicle, at experimen	val vehicle	that employ	ys the Terrastar loco-
motion concern: was tested on soils having	z vide range	of streng	ths, on asphalt pave-
ment, and in water. The purpose of the tes	ts was to de	termine (a) the minimum soil
strength, in terms of rating cone index, th	at will nerm	it the veh	icle to complete one
and 50 passes in a straight-line path (i.e.	the vehicle	cone inde	x for one pass. VCI1.
and 50 passes, VCI50), (b) one-pass drawbar	a dita lim	nd motion	resistance-soil
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strength relations, (c) hard surface draws	r parr-venic	met semant	lities Muchanical
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breakdowns prevented completion of some por	ברים OI Che	test prog	Tour a the experi-
mental VCI 50 was determined to be 21 and ch	e experiment	at ACIT' to	De O. This compares
favorably with the computed VCI of 2' and	computed vo	11 OT 14.	THE BUXIETH GLEADER
pull on a paved surface vas 65 percent of v	ehicle veigh	t; the max	imum drawbar pull on
soil was about 57 percent of vehicle weight	. Maximum d	ravbar pul	l and motion resist-
ance were shown to be related to soil stren	gth. The ma	ximum vate	r speed was 3.0 mph.
Amender & presents the fromle and commute	tions for de	terminatio	on of the vehicle

KEYWORDS: Field tests; Mobility; Pavements; Terrastar locomotion concept; Trafficability; Water performance

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12. ABSTRACT	·	· · · · · · · · · · · · · · · · · · ·
The data shown indicate that a mathematica	l representa	tion of pneumatic tire, in
terms of the deflections of Many radial se	gments, succ	essfully displays the es-
sential feature of horizontal and vertical	forces tran	smitted through the tire.
It is indicated further that the segmented	tire model	enables realistic predictions
to be made of the displacement and force t	ime historie	s for a pneumatic tire towed
over a rigid obstacle.		
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KEYWORDS: Mathematical models; Obstacle-wi	neel interact	tion: Obstacles: Ride
dynamics; Simulation; Tire defle	ection; Pneu	matic tires
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19. ABSTRACT Current theoretical concepts of	f the soil-ru	nning gear	interaction are based	
on empirical pressure-sinkage and shear :	stress-displa	cement rela	ations. It was found	
that the tests from which these relations best, to the soil-running gear interactions	on. In parti	cular, the	use of the shear	
stress-displacement relation for an anal	ytical evalua	tion of the	e shear stresses at	
the contact surface of rigid wheels on so because equations obtained by the bevame				
behavior in the intermediate state, which	n is a state	between the	e elastic and plastic	
states. Recent publications point out to vicinity of a powered wheel is in a state	hat part of t	the soil in	the immediate	
quasielastic state. Thus, the soil-bevar	meter interac	tion is of	a fundamentally dif-	
ferent nature than the soil-wheel intera-	ction, which	makes resu	lts of such tests un-	
suitable for predicting wheel performance rigid wheel and dry sand is based exclusi	e. Selas to ively on the	shear stre	ss-displacement con-	
cept, and thus provided an excellent mean	ns of checkir	ig the conc	ept as a whole.	
Using a simple approximate relation between normal stress ratio taken over the total				
means of constant-slip rigid wheel tests	 The expert 	mental fine	dings strongly sup-	
ported the conclusion that shear stress-displacement relations are irrelevant to soil-wheel mechanics. A new theory was developed to assess the variation of the				
shear-to-normal stress ratio along the s	nil-whoel int	erface wi	thout referring to	
shear stress-displacement relations. Th	is is a subje	ct of anot	her paper.	
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KEYWORDS: Soil-wheel interaction; Stress-strain relations (Soils); Stresses				
under wheels				
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A MATHEMATICAL MODEL FOR TRAVERSAL OF RIGI	D OBSTACLES	BY A PNEUM	ATIC TIRE		
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13. ABSTRACT					
The mathematical model for a pneumatic tire described in this paper is used to compute the horizontal and vertical forces transmitted through the tire to the vehicle axle to provide realistic force inputs for model studies of vehicle dynamics. The present model is valid for the case of a pneumatic tire traversing nondeforming obstacles with zero slip. Static load-deformation characteristics and dynamic obstacle-traversal characteristics were obtained in laboratory test with 9.00-14 tires under several conditions of ply rating and inflation pressure. These data were used to calculate model parameters and to produce time histories of dynamic responses. Computer implementation of the mathematical model produced force and displacement time histories similar to those obtained during the obstacle-traversal laboratory tests. The model produced the essential features of the waveforms seen in the laboratory and is a valid representation of a pneumatic tire for dynamic analysis of vehicles on nonyielding terrain.					
REYWORDS: Mathematical models, Mobility; (tires; Ride dynamics	Obstacle-whee	el interact	ion; Pneumatic		

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INTERFACE	UNING SINESS	MAILU AI	INE SOIL-MILLE	
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		ry Materiel	Command	
	Washington, C. C.			
13 ABSTRACT	<u> </u>			
An attempt is made to theoretically assess the variation of the shear-to-normal stress				
ratio, t/o, along the soil-wheel interface without referring to shear stress-				
displacement relations believed to be irrelevant. Based on recent investigations of				
the soil rupture pattern beneath rigid wheels on cohesionless material, the total soil-wheel interface is subdivided into three zones of different soil behavior.				
Simple assumptions are made of the soil-to				
evaluate t/o . Experimental checks showe				
better agreement with the test data than w	ere previous	sly develor	ed theories.	
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KEYWORDS: Soil-wheel interaction; Stress-strain relations (Soils); Stresses under				
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Fresented at the CAL-ISTVS Off-Road Mobility Research Symposium in Washington, D. C., 26-27 Jun 68.

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U. S. Army Materiel Command Washington, D. C. 20315

Existing research facilities at U. S. Army Engineer Waterways Experiment Station (WES) are being utilized in a systematic approach to developing and validating more reliable models of the man-vehicle-terrain system. Specific attention is being given to developing more realistic models of tires, tracks, and deforming soil. The dynamometer systems at WES are being utilized to evaluate these models and to determine dynamic characteristics of certain tires and track systems. High-speed computing facilities are being used extensively, and capabilities for in-house simulation activities are being increased. Obstacle courses and test tracks will be used to evaluate analytical models and assess the validity of criteria for determining ride quality and/or vehicle speed.

KEYW JRDS: Mathematical models; Mobility; Mobility research laboratories; State-of-the-art studies; Vehicle dynamics; [Waterways Experiment

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LIMITED TEAFFICABILITY TESTS WITH MAJO	OR/MINOR WH	EEL VEHIC	LE EQUIPPED WITH	
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James H. Robinson				
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The major/minor wheel vehicle is an experimental				
cept. A previous test program was conducted with whereas in this program the vehicle was equipped				
program was to determine whether the larger tires				
eters were go or no-go, one and 50 passes, in soft	t soil; maximu	m water spe	ed; water exit; and ver-	
tical step height capabilities. Mechanical breakdow	ns reduced co	nsiderably th	e amount of testing	
compared to that anticipated at the start of the p	rogram. Com	parison of the	ne results of the two pro-	
grams shows that the larger tires reduced one-pass creased maximum water speed from 2.8 to 3.1 mg				
with the larger tires. A vertical step height of 22				
tires. Step height tests were not attempted with				
KEYWORDS: Field tests; Mobility; S	oft soils:	Soil-wh	eel interaction:	
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A series of reports prepared by the Joint Thai-U. S. Military Research and Development Center were reviewed to determine the effects of jungle trail features, especially trail width, on performance of the M274 1/2-ton Carrier and two concept vehicles, one 65 in. and the other 80 in. wide. In these reports it was generally concluded that vehicles whose widths approached 90 in. experienced difficulty along the trails. Overhanging vegetation and fallen trees restricted driver visibility and damaged windshields of vehicles whose heights were about 80 in. or more. Slippery soils and steep streambanks plagued trail operations; deep ruts in the trail surface also caused considerable problems. Nonamphibious vehicles experienced numerous engine failures in fording operations. Streams deep enough to float vehicles had current velocities less than 3 mph. Based on the review of these reports, the following suggestions are made. The vehicle should be less than 90 in. wide and less than 80 in. high. Ground clearance should be greater than 18 in. and the underbody should be smooth. The turning radius should be less than 15 ft. The traction elements should have the traction capabilities of a track and the low maintenance requirements of a wheel. The vehicle should be amphibious and should be able to maintain directional control against a current velocity of 3 mph. However, if nonamphibious but equipped with waterproof ignition and exhaust systems, the vehicle would meet approximately 90 percent of the requirements for water crossing. The vehicle should have a high-capacity winch and power steering or easy steering capabilities. Ground pressures in the order of 2 psi or less are desirable for soft soils that may be encountered.

KEYWORDS: Field tests; Jungle trails; Military vehicles; Mobility; Self propelled vehicles; Terrain analysis; Trafficability; Tropical regions; Utility carrier

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A desk study was performed to determine the effects of vehicle and vegetation characteristics (particularly vehicle width) on vehicle performance. The 1/2- and 3/4- ton, 8x8 vehicle concepts and the 1/2-ton, 4x4 M274A2 Mule were included in the study, and performance predictions were made for 150 wooded vegetation sites located in a variety of environments. Vehicle performance was evaluated by analyzing the predicted performance data obtained from the application of the WES analytical model for predicting country performance. For this study, performance predictions were made in terms of speed and delivery rate as a function of vegetation stem size and spacing and vehicle characteristics only. The results if the study revealed that the M274A2, with the narrowest width, lowest power, and smallest payload, had the least number of immobilizations and the lowest average . eed and delivery rate; the 1/2-ton vehicle concept with an intermediate width, power, and payload, ranked second in the number of immobilizations, had the highest average speed, and ranked second in delivery rate; and the 3/4-ton vehicle concept, with the greatest width, power, and payload, had the highest number of immobilizations and the highest average delivery rate. It was also concluded that the poorer performance of the 3/4-ton vehicle concept as compared to the 1/2-ton vehicle concept may be offset by incorporating the General Electric Co. hydromechanical power train described herein.

KEYWORDS: Military vehicles; Mobility; Performance predictions; Performance tests (Vehicles); Utility carriers; Vegetation factors

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THE ROLE OF GROUND CRAWLING VEHICLES IN TH	E OCEAN					
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As undersea techn logy is quickening its pace, the need for ocean-bottom vehicles is becoming increasingly obvious for many anticipated underwater activities, such as inspection of cables and pipelines, scientific exploration, and commercial exploitation (mining and farming) of and construction on the seafloor. Submersibles designed for a three-dimensional environment are inadequate for operation on or near the essentially two-dimensional seafloor. In contrast to submersibles, ocean-botton crawling vehicles are stable even while at rest, because they are in direct contact with the seafloor, which also provides the necessary reaction forces to perform useful work. Some ocean-bottom vehicles are already available, and more are under construction; but a comprehensive study of seafloor trafficability and wehicle mobility has not been made. This paper presents the state of trafficability and wehicle mobility has not been made. This paper presents the state of trafficability to the seafloor environments. The mechanical and geom-trical properties of the ocean bottom are briefly analyzed in the light of trafficability concepts. Various running gears are compared as to their suitability for the ocean bottom, and their advantages and disadvantages with respect to slope-climbing ability, drambar pull, effect on turbidity, etc., are presented. Since off-road mobility research is basically empirical, definite conclusions cannot be drawn without adequate support by laboratory and in situ testing. This paper is an outgrowth of a U. S. Army Engineer Waterways Experiment Station contract report for the U. S. Naval Civi. Engineering Laboratory, in which more details and a minimum test program to establish a racional basis for mobility prediction of ocean crawling vehicles can be found. KEYWORDS: Mobility; Ocean bottom vehicles; Trafficability						
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KEYWORDS: Cone penetrometers; Fine-grained Soil penetration tests	soils; Penet	ration res	istance (Soils)		

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The analysis of linear viscoelastic layered systems under any axially symmetrical, time-dependent surface traction is presented. Inertial effects are disregarded, and solutions are obtained for the normal, radial, and shear stresses, vertical deflection, and radial displacements at any point within the half space in multilayered systems. Solutions in layered elastic systems first are obtained by using the Love's stress function and the Fourier-Henkel transformation. Solutions in viscoelastic cases then are obtained by using the elastic-viscoelastic correspondence principle, in which the Laplace transformation is applied to replace the time variable with a transformed variable, and thus change the viscoelastic problem into an associated elastic one. The solution of the associated elastic problem, when transformed into the real time variable, will give the desired viscoelastic solution. Sample numerical results are presented. The analysis is an essential step in the development of a rational method of design for flexible pavements, since such pavement systems respond in a markedly time-dependent fashion.

KEYWORDS: Displacement; Flexible pavements; Layered systems; Stress-strain relations; Viscoplasticity method

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Thomas B. Rosser III Steve L. Webster				
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13. ABSTRACT Laboratory tests were conducted to evaluate the accur	and soliabi	line of mason	ring surface in sure coul	
water content and density by the backscatter and direct				
device and scaler. The nuclear device functioned as a				
a direct transmission density probe. To determine the				
sary to know the actual density and water content of				
sions, filled with uniformly compacted soil, and weight lated. Five soil types were tested to approximate a fu				
type was tested at eight different densities and water of	-			
ties of each sample were determined by two accepted				
for determining density in the field. Test results indic				
transmission nuclear method using the factory calibrate				
as densities obtained by the sand-cone and water-balloon methods. The direct transmission nuclear method				
using a WES-developed calibration curve provided slightly more accurate density measurements than either				
conventional method. Densities determined by the surface backscatter nuclear method using both the fac- tory calibration curve and a WES-developed curve were not so accurate as those obtained by the conven-				
tional methods. Water contents were obtained by nuclear means and compared with actual water contents				
determined from ovendried samples. Using a WES-devi	eloped calibrat	ion curve, wa	iter contents obtained by	
the nuclear method were sufficiently accurate for most	t quality contr	ol fieldwork.	Water contents obtained	
using the factory calibration curve were not accurate e				
ing surface layer density and water content of soil by KEYWORDS: Measuring instruments; Nu determination: Water cont	nuclear methodiclear methodiclear	ns is presente hods; So	a in Appendix A Ll density (Soile)	
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oratory tested in . fine sand to determine their relative performance and to establish a better understanding of the basic principles of the interaction of very lightly loaded wheels with a soil whose properties were varied to include the probable range of lunar soil properties. Programmed-slip tests were conducted with the single wheels and the vehicles, the latter being tested on both slopes and level surfaces. Data indicate that for loads less than about 220 N (501b), the pull/slope-climbing ability was constant for a given soil condition. At greater loads, the rate of increase in performance decreased The effect of cohesion on performance was negligible at loads less than about 220 N (50 lb), but the effect could be seen at higher loads. The results of tests with the metal-elastic wheels showed that none could be relied on to propel a vehicle up a 35deg slope. Modifications of the Bendix and Grumman wheels enhanced their performance to the point that they might be expected to climb slopes in excess of 30 deg. Tests with modified Boeing-CM wheels indicated that they might be used on slopes up to about 25 deg on certain soil conditions. The power required, in whr/km, for operation of the wheels on level and sloping soil surfaces was determined. It was demonstrated that data from single-wheel tests can be used to predict the slope-climbing ability of a vehicle; such predictions tend to be slightly conservative. Results of tests with the vehicles indicate that the torque coefficient at a given slip was not significantly affected by variations in surface slope and soil strength.

KEYWORDS: Laboratory tests; Lunar roving vehicles; Sands; Soil-wheel interaction; Wheels

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3. REPORT TITLE					
EFFECT OF PRESSURE DISTRIBUTION UNDER PHEU	MATIC TIRES	ON STRESSES	S AND DISPLACEMENTS		
IN THE SUPPORTING ELASTIC MEDIA					
4. DESCRIPTIVE NOTES (Type of report and inclusive delea)					
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Summary published in Highway Research		y Materiel	Command		
Record, No.345, 1971.	Washingto	n, D. C.			
13. ADSTRACT					
The validity of the assumption of uniform p	oressure dis	tribution w	ınder a pneumatic		
tire was checked in this study. Measuremen					
matic tires at their interface with firm s					
the U. S. Army Engineer Waterways Experimen					
12-PR, and 12-22.5, 12-PR) tested at three	inflation p	ressures ()	104, 207, and 414		
kN/m ²) and under wheel loads ranging from (6670 to 20,0	30 N were	investigated. Stres-		
ses and displacements were computed by the	theory of a	lasticity :	for various depths		
in the half-space under loading conditions					
bolic, and assumed conical pressure distril	butions. Ge	merally, th	ne assumption of uni-		
form pressure distribution was found to be					
tires on a hard surface and on sands, but	it was found	acceptable	in the other inves-		
tigated cases, including those for clay sur	rfaces. How	ever, the a	essumption of para-		
bolic pressure distribution was found to be					
for high-inflated tires on sands and for le	w-inflated	tires with	light load on loose		
sand.			ì		
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A PLAT FOR QUANTITATIVE EVALUATION OF THE	CROSS-COUNTY	RY PERFORM	VICE OF FROTOTYPE	
VEHICLES				
4 DESCRIPTIVE NOTES (Type of report and inclusive dates)				
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Jack K. Stoll				
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	Washingto	on, D. C.		
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13. ABSTRACT				
A method of evaluating the cross-country				
descriptions of the terrain and a mathema				
to vehicle performance is presented. A d				
gives & ressure of cargo delivery over a				
considering speed made good, loading and	w.leading ti	me, servici	ing time, cruising	
range, and cargo capacity. The vehicle p				
trated by applying them in a comparative	analysis of	the 137 and	1 2361 cargo trucks	
traversing selected terrains in the vici.				
terrain raps and mobility maps (in terms				
ate the relative performances of the M37	and Thul ar	e includes.	. Appendixes present a	
tentative selection of "standard terrains	" that could	be used 1	evaluating relative	
performances of vehicles and a first-gene	ration compu	ter program	n for predicting steed	
performance. It is recommended that rese	arch be cont	inuel to 1:	trove the reliatility	
and scope of the mathematical model for p	redicting ve	kicle perio	ormance and that areas	
of the world be selected and mapred as st	andard terra	ins for use	e as performance	
evaluation bases.				
KEYWORDS: Computerized models; M				
Offroad mobility; Performaps	ormance pr	edictions	s; Terrain factor	

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3. REPORT TITLE	·		
TESTS WITH AN EXPERIMENTAL WHEEL ON CLAY			
4. DESCRIPTIVE NOTES (Typo of report and inclinity dotes) Final report			
S. AUTHORIS) (First name, middle initial, last name)			
Klaus W. Wiendieck			
e. REPORT DATE December 1970	>4 TOTAL NO. 01	F PAGES	75. NO. OF REFS
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An extension of a previous study on sand, the obtained on clay with an experimental wheel. The test program was carried out for the salthe underlying principle of the experimental and, therefore, similar wheel performance vidistribution were not to be expected on classicapacity of the wheel-drive system preventes and study from being applied in this study. The relation of pull/load to efficiency was be used in this investigation. As expected could be observed for rigidity pattern variabution at the interface is not effective in ative, it confirms the earlier findings on wheel with controlled circumferential rigid:	with controlle of complete wheel was variations as by. In addition of the perform on clay. The only feel, no notice ations. Controlle of the improvement of the improvement of the controlle of the improvement of the improv	eteness des based upon s a function tion, insuf- mance crit- easible rel able change introl of ti- hough this	unferential rigidity. Spite the fact that It is sand properties On of tire rigidity Efficient torque Steria used in the Lation that could Steria in tire behavior Iter rigidity distri- conclusion is neg-
KEYWORDS: Clays; Laboratory tests; Rigid wh	wels; Soil-1	wheel inter	action:

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LIMITED PERFORMANCE TESTS OF THE XM759, 1-	1/2-TON LOGI	STICAL CAR	RIER, AMPHIBIOUS	
4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report				
S AUTHORISI (First nome, middle initial, last name)				
Barton G. Schreiner Edgar S. Rush				
6 REPORT DATE	74. TOTAL NO D	PAGES	7b. NO. OF REFS	
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Distribution limited to U. S. Government agencies only; test and evaluation of military vehicles; December 1970. Other requests for this document must be referred to the U. S. Army Engineer Waterways Experiment Station.				
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	U. S. Arm Washingto	y Materiel n, D. C.	Command	
Limited performance tests were conducted w Amphibious, at test sites near Vicksburg, 1970. The purpose of the tests was to pro- development program with some urgently nee- vehicle's performance such as steering cap- faces on slope-climbing capabilities of sm tread tires, effects of tread design on pe- vegetation buildup, and other performance the findings of these tests have been inco- report serves to document the data upon wh Generally, the findings were as follows. the best slope-climbing and drawbar pull p- ance of the XM759 was as good as or better However, performance of the XM759 with bar- vehicle (PV)5 modifie: with 25x24-8R chevro- 17,48C lb performed as well in marsh areas a gross weight of 14,030 lb. Appendix A p- effects of tread-plate configuration and se KEYWORDS: Amphibious vehicles; Field test- Slope performance; Soil buildup Trafficability; Utility carriers	Miss., and invide personned informat abilities in ooth (treadler formance in capabilities reporated in ich the develor formances of than that of the develor formances on tires and as PV4 with resents resulurface condities; Mobility; (Vehicles);	n Virginia el responsi ion on cert water, efi ess) tires marshland, of lesser the develop lopment dec sign tires on wet clay f the M116 in marshla having a g 24x21-6R s lts of a la tions on tr	in 1967, 1968, and the for the overall cain aspects of the fects of slippery surand bar- and chevrongefects of soil and significance. Most of oment program; this cisions were made. On the XM759 afforded surfaces. Performtracked cargo carrier. Inds was poor. Pilot gross weight of mooth tires and having aboratory study of the faction.	

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S REPORT TITLE		<u> </u>		
FVALUATION OF SOIL STRENGTH OF UNSURFACED I GROUND VEHICLES	PORWARD-AREA	AIRFIELDS	BY USE OF	
4. DESCRIPTIVE NOTES (Type of report and instantre dates) Final report				
George M. Hammitt II				
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13 ABSTRACT				
This report describes a method for rapidly area airfields. Through the use of dimensi by the U. S. Army Engineer Waterways Experi determined by measuring rut depths created hicles. This method enables reasonably accommel without special training and without soil strength existing in the forward areas cerning the ability of a particular site to tially, an office study was conducted that method. Then limited field verification to military ground vehicles, i.e. a 1/4-ton MI a 5-ton M5, operated on a prepared unsurfated empty and for all but the M55 with man of this testing indicated the feasibility of a particular forward-ar aircraft traffic. It is recommended that	ionless ground iment Station by traffic of curate assess to the use of some is known, possible successions as a substain special established ests were consist, a 3/4-to acced heavy clipths were meaking configurations. This rea airfield further studi	nd mobility, soil standarsment of s special is prediction ecific air the poten mucted with M37, a say subgransured for country log soil straightful st	y parameters developed rength indication: are dimilitary ground veloil strength by pernatruments. If the scan be made concraft traffic. Initial of such a th four standard 2-1/2-ton M35A1, and de with a strength each vehicle operading. The results ength based on one-can be used to prena specific small	

airfields

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KEYWORDS: Military vehicles; Mobility; Soil strength; Unsurfaced

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SOIL STRENGTH CRITERIA FOR OP AIRFIELDS: BARE BASE SUPPORT;			FT ON UNSURFACED
4 DESCRIPTIVE NOTES (Type of report and inclusive da Final report	100)	 v 	
6. AUTHOR(3) (First name, middle initial, last name)	····		
Donald M. Ladd			
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11. SUPPLEMENTARY NOTES			
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13. ABSTRACT			
The purpose of this study was to obt	tain necessary data	to validat	e or modify, if neces-
sary, existing soil strength criters	ia for the operation	n of high-p	erformance jet fighter
aircraft on unsurfaced airfields.	Two specially prepar	red test se	ctions were constructe
with four test items in each section			
items and two heavy clay test items.			
sand, lean clay, silt, and heavy cla			
F-4C-type loading, and the results v	were used to obtain	criteria f	or operation of
fighter-type aircraft on unsurfaced	soils. Skid tests	were also	conducted on these
test sections to simulate the effect	s.of braking on uns	surfaced so:	ils. Results of the
traffic tests indicated that existing	ng criteria are adec	quate for u	se in designing unsur-
faced airfields for the rolling load	is of fighter aircre	ift. Analy	sis of the skid test
data indicates that unsurfaced airfi	elas constructed of	solls with	strength that is
primarily dependent on the angle of stand maximum braking loads of fight	internal iriction mer almovatt	ay not be	idequate to with-
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KEYWORDS: Bare base support;	Fighter aircraft	t; Soil st	rength; Unsurfaced
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STANDARD PENETRATION TEST AND RELATIVE DEN	SITY		
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S. AUTHOR(S) (Fire' anne, middle initial, last name)			
Klaus-Jurgen Melzer			
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Fourth Pan American Conference on Soil Mechanics and Foundation Engineering, San Juan, Puerto Rico, 14-18 June 1971, Proceed Vol II.	l.	y Materiel	
Since ground water greatly influences penerelation was established between the number tration test to sand below ground-water let to air-dry sand at the same relative densifound to depend not only on the relative de the grain size of the penetrated sand, and the number of blows and the relative densifound to determine the same transport of the same transport of the penetrated sand, and the number of blows and the relative densifound the same same transport of the same same same same same same same sam	r of blows a vel and the ty. Also, s ensity but a empirical re ty, with com n was verifi	pplied in the correspond ince the mail of the mail of the lation was pactibility	the standard pene- ing number applied umber of blows was compactibility and developed between y and mean grain.
KEYWORDS: Penetrometers; Sands; Soil densi Soil penetration tests; Unit wei	ght determin	nation	ring devices; assified

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THE PERFORMANCE OF TWO BOEING-GH WHEELS (G MANNED LUNAR ROV		VIII) FOR	₹ THE
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report.			
B. AUTHOR(3) (First name, middle initial, last name)			
Anarew J. Green Klaus-Jurgen Melzer			
S. REPORT DATE	74. TOTAL NO. OF	PAGES	75. NO. OF REPS
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13. ABSTRACT		~ 1	
Two candidate wheels for the Boeing-Covered and one constructed of open-wire min a fine sand. Four levels of sand strengfrom zero to 0.15 psi, were used in the teties of the sand spanned a range that is blumar soil properties.	esh, were testigth, representations. The col	sted for m nting cohe hesional a	mobility performance esion values ranging and frictional proper-
A dynamometer system was used to conduct possip was varied from a negative slip of 15 were tested at the average design load (59 the insluence of load imbalance and dynamic average speed at 0 percent slip was 3 ft/se	of to a positi 1 lb) and at 7 1c load transf	ive slip o 75 and 125	of 100%. The wheels
The test results show that the covered tractive performance (pull/weight ratio = slope) in the two strongest soil conditions open wheel was not able to achieve this traconditions tested. In the same soil conditions the open wheel was consistently less than	0.47, equival s, but not in active perfor tion, the max	lent to cl n the two rmance in ximum pull	limbing a 25-deg weakest ones. The any of the soil L/weight ratio for
KEYWORDS: Lunar roving vehicles; Sands; So Lunar Rover Vehicle]	il-wheel into	eraction;	Wheels; [Boeing-GM

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4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)				
Final report				
5. AUTHOR(5) (First name, middle initiel, lest name)				
Claude A. Blackmon				
Adam A. Rula				
S. REPORT DATE			·	
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Published in Event Dial Pack Symposium	1			
Report, Vol II, Project LN 309, Mar 1971.			ort Agency	
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13. ABSTRACT	<u> </u>	·		
Event Dial Pack, a 500-ton spherical TNT ch	arge tangent	to ground	cumface the data	
nated on 23 July 1970 at the Defence Resear	ch Establich	mont Cuff	ioli (DDDC) Doleten	
Alberta, Canada. Project LN309: "Effectiv	eness of Cra	tere se Ro	rriers to Mobility "	
was included in the program of United State	s sponsored :	nroiecte m	ertaining to the mount	
The objective of Project LN309 was to determ	mine the deg	ree to which	nh a cratar and ita	
associated ejecta field constitute a physic	al barrier t	n the move	mant of militame mahi	
cies. Four terrain units in the crater and	eierta area	ware deli	desirates on boton	
to ground mobility and described in terms of	f soil stren	oth coil a	maintuma contant cum	
race configuration, ejecta depth, and areal	extent. Per	rformence	tect data obtained	
with an M3 (3/4-ton truck and an M113A1 arm	ored nerconn	al commics	******	
mine periormance degradation in each terrai:	n unit. Veh	icle nerfo	monoo in the termein	
miles identified was predicted using the new	cessarv elema	onte of the	Waterwayee Domanianat	
station analytical model for predicting off.	-road vehic.	Aprforma	ter termosambro nor	
predicted values for four performance narem	tore (drowho	- Ties we		
sistance, and speed) were compared. The ac-	niracy of the	· rmadiati		
war periormence parameters except that the	ineeds aredi	14 mad fam 41	m toppoin unit /t.	
lip) that provided the least resistance to	otion were l	igher than	the measured values.	
KEYWORDS: Crater ejecta; Craters; Explosion Obstacles; Performance prediction	n errects; W	LLITARY Ve	nicies; Mobility;	
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This report summarizes published results as	nd personal co	omments of	a number of re-
searchers who have used synthetic soil mix	tures. It als	so contains	s a small amount of
data collected at the Waterways Experiment Station. In general, it can be said that			
whereas synthetic soils may be useful in so	ome limited so	ense, they	do not offer the
panacea that earlier researchers claimed or			
many synthetic mixes may be more dependent those of soil-water mixes. It is concluded	on temperatu	re and rate	e or idading than
engineering research is rather limited, and			
thoroughly study the behavioral patterns pe			
plan to use lest the utility of the information	tion produced	i be restr	leted by them.
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This report explains how the user car conversational mode using a teletype model permits the user to predict the contact vehicle over any solected ter average fuel consumption in gallons of the computer code, written in FORTRAI routines. The first subroutine, AREA combination of slope, soil strength, geometry features; the second subrout tures such as streams, ditches, etc. face irregularities of uniform or nor program and three subroutines is demotained by utilizing data files compil selected from data files or input as option to substi the new values for sychicle design soldies.	connected to a Comparation of the performance of the permitter of the perm	E-435 computany specific average speciavery rate in a main prograin charact distribution siders elong subroutine, shape, and special tary vehicles subroutines as subroutin	eer. The analytical ed conventional grounded in miles per hour, in ton-miles per hour. Gram and three sub-cerized by a specific as of trees and microgated depressed feaceptoff, considers surcing. Use of the maine examples were object and terrains. The user has the	
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EFFECT OF DESIGN CHANGES ON VE (MODIFIED) AND THE MILIAN	HICLE PERFORMANCE; A LI	MITED STU	OF THE M35A2
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The AMC Analytical Model for P in this study to investigate t vehicles. The existing vehicl two vehicles selected were the armored personnel carrier. Ar vehicle characteristics—gross power plant—resulted in a tot 9 tracked. The 30 terrain unit soils, represented, a fairly vehicle changes and showed how study should that a knowledge design change. The study also the performance of a vehicle in unit as a design tool to specificated to operate. The study expected in some terrains from those of performance in other to	he effects of design ches were examined in 30 M35A2 (modified) 6x6 2 bitrary design changes weight, size of tires al of 18 different vehits, 20 in fine-grained de range of terrain cone analytical model to p the effects varied with of the terrain is essen pointed out that rarel n all terrain condition fy the scope of terrain demonstrated the improvates a design change, but i errain conditions.	anges on p different -1/2-ton t that were or track, cle version soils and ditions. redict the terrain c tial to the y will one s and that in which ement in p t also poi	terrormance of existing terrain units. The cruck and the M113Al made on four principal suspension system, and ns, 9 wheeled and 10 in coarse-grained The data and analyses effects of specific conditions. Hence, the evaluation of any design change improve the model can be a vehicle may be exertormance to be nted out the degrada-
Performance pr	les; Mobility model edictions; Personno e design:[M35A2 (Vo	el carrie	ers; Terrain;

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Unclassified M Security Classification DOCUMENT CONTROL DATA - R & D Security classification of title, body of matrices and indexing annotation must be entered when the everall report is classified) 34. REPORT SECURITY CLASSIFICATION Unclassified U. S. Army Engineer Waterways Experiment Station SA SROUP Vicksburg, Miss. S. REPORT TITLE OPERATIONS AND MAINTENANCE MANUAL FOR A SCALE-MODEL LUNAR ROVING VEHICLE 4. DESCRIPTIVE NOTES (Typs of report and inclusive dates) Final Report S. AUTHOR(S) (Piret name, middle initial, lest name) Allan S. Lessem REPORT DATE 78, NO. OF REFS 74. TOTAL NO. OF PASES April 1972 59 A CONTRACT OR GRANT NO. e. ORIGINATOR'S REPORT NUMBER(S) A PROJECT NO. Miscellaneous Paper M-72-3 95. OTHER REPORT NO(5) (Any other mumbers that may be seeigned c. NASA - Defense Purchase Request No. H-72026A AD 757 392 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. 11. SUPPLEMENTARY HOTES 12. SPONSORING MILITARY ACTIVITY George C. Marshall Space Flight Center National Aeronautics and Space Administration, Huntsville, Alabama 13. POSTRACT A one-sixth scale model of the Lunar Roving Vehicle used in the Apollo 15 mission was built and instrumented to conduct model studies of vehicle mobility. The model was free running under radio control and was equipped with a lightweight telemetry transmitter that allowed 16 channels of data to be gathered simultaneously. String payout and fifth-wheel devices were developed to measure vehicle velocity. Other realtime measurements included wheel torque, wheel speed, center-of-gravity accelerations, and steering forces. Calibration, operations, and maintenance procedures were

worked out. Details of the development of the instrumentation, its maintenance, some of the problems encountered, etc., are recorded in this report to serve as a preliminary operations and maintenance manual for this specific model. In addition, information regarding soil processing and testing that may be useful to NASA personnel planning mobility research with the model in soil is furnished.

KEYWORDS: Laboratory tests; Lunar roving vehicles; Mobility; Scale models

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13. Assyract Laboratory tests were conducted to determi	na sebiah mat	had of abo	sining firm different	
soil-to-rubber shear measurements with two				
and a spline shear device, would produce t	the wost cons	istent was	surements or quen-	
titative indexes of surface soil strength.	The tests	were made	at 3k.5 68.9 and	
103.4-kM/m2 normal pressures on a fat clay	vhose surfa	ce moisture	content ranged from	
26.5 to 45.9 percent. It was found that p	eak shear me	asurements	for the full range of	
soil strengths used could be obtained only	at the norm	al pressure	e of 34.5 kH/m ² be-	
cause of excessive sinkage of the shear he	ad at the hi	gher norma	l pressures in the	
softer soils. The peak shear measurements	with the Co	hron shear	graph, with an in-air	
calibration, at a normal pressure of 34.5				
recommended for further study to determine	their valid	lity in sur	face condition-	
vehicle performance research.				
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This report presents data on the			
various types of proving rings and frames un			
forces or loads in laboratory and field test terials. The first part of the report pres			
tion of deflections and moments in thin circ			
elliptical rings, flattened rings, rectangui			•
sections, and compound cantilevers. Some or			
and textbooks, but other equations are not :	readily avai	lable and	were developed by ap-
plying standard methods of the theory of ele	asticity to:	relatively	thin structures. The
second part of the report deals with the in			
as large deformations which can cause appre			
grams. Rigorous equations for thick rings; thick devices. Empirical data on fillets as			
the approximate stiffening effect of fillets			• -
in which only angular deflections caused by			
misalignment, creep and hysteresis, and tem	perature var	iations is	discussed briefly.
The last two parts of the report present ex			

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and frames proposed for use or actually used in testing equipment. General design procedures using the basic equations are proposed, and data are presented on suitable materials, including recent alloy steels capable of age or precipitation hardening, which eliminates the distortion often caused by heat treatment and quenching of other steels. The final sections deal with rough calibration before hardening and final machining and corrections of dimensions if needed, which are followed by repetitive loading to slightly above the rated capacity before the final calibration in order to decrease the

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This paper presents techniques for analyzing relative surfacing requirements for container-handling equipment. Its primary object is to emphasize the importance of evaluating the effects of vehicle characteristics on surfacing requirements prior to procurement of specific vehicles. At the present, cross-country mobility and the effect that vehicles have on bridges are the only military engineering considerations that have had a major influence on equipment design and selection. Container-handling equipment is broken down into five major categories: forklifts, straddle carriers, yard gantries, mobile cranes, and tractor-trailers. Examples of each of these categories plus the LARC LX amphibian were evaluated for operation on four different sur-The Waterways Experiment Station VCI system was employed to determine their ability to operate on beaches and soils of limited strength. The criteria for operation of aircraft on unsurfaced areas were used for medium- and high-strength soils, and criteria for the design of military roads and airfields were employed in the analysis for MBAl landing mat and flexible pavement. Results of the study indicate that exceptionally large amounts of engineering support will be required for some types of equipment such as the large mobile cranes. None of the equipment was particularly suited to beach operation although it would be possible for some items to operate with limited payloads on dense sands. The MBAl light-duty landing mat was found to be satisfactory only for two types of equipment and for periods of limited duration. study also pointed out the need for a better understanding of traffic patterns within container storage areas and the statistical distribution of gross container weights. Container handling vehicles; Mobility; Off-road vehicles; Requirements; Surfacings **KEYWORDS:**

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ing daily soil moisture contents and streng				
index) of soil layers at depths of 0-15 and model includes soil moisture accretion and				
mum soil moisture contents, moisture content				
soil moisture-strength relation, daily rain				
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sources: (a) directly from measurements at				
estimated or averaged data derived from fie				
equations built into the model; or (c) indi	rectly from	a surface	composition group	
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puter program for the model is written in Fo				
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or for input to platting progress. The main	herrormance h text of th	e sebost ; breatcetou	ncludes a dismission	
or for input to plotting programs. The main text of the report includes a discussion of the structure, operation, use, limitations, and mathematics of the model. Appendixes				
A-G include detailed flow charts and listing				
zation, and format of input data; examples	of predictio	n runs and	graphic displays of	
results; and procedures for converting outp	ut data to t	erms requi	red by the airfield	
construction effort model.				
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A technique based on the U.S. Army Engin	eer Waterway	s Evnerime	ont Station mobility	
prediction system was developed for predi	cting power	requiremen	ts as a function of	
system output (pull coefficient) for a gi	ven wheel eq	uipped wit	h a pneumatic tire	
operating on clay and in a range from tow	ed to 20 per	cent slip.	In addition.	
separate relations of system output and s	ystem input	(torque co	efficient) as func-	
tions of slip can be predicted. Comparis	ons with dat	a from veh	icle field tests show	
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This report describes a method for applic	.44 45	1100 1101 A	AT14 1 - 4	
helicopters and related ground support eq	ation of the	MES ACIVE	Ul criteria to	
mobility submodels developed by WES and t	he soil stree	ough the	nse or Gronna	A
for one helicopter (CH-47A), comparative	performance	enebiliti	es are determined	iu. I
on the basis of wheel sizes and loads and	sinkage into	the grow	nd. Estimates er	'e
made of the performance requirements of t	be AH-56A be:	licapter.	and the applicati	on
of drawbar-pull capabilities of selected	ground vehic:	les to tow	ing the AH-56A ar	e
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13 ABSTRACT				
Event Mixed Company III, a 500-ton TNT ber 1972 at Grand Junction, Colorado, near				
of Craters as Barriers to Mobility," was in				
by the United States pertaining to the ever				
determine: (a) the degree to which a crate				
tute a physical barrier to the movement of				
was impassable, the amount of engineering eroute for the vehicles under consideration.				
surface) in the crater area were delineated				
described in terms of soil strength, soil m				
ejecta depth. Go-no go mobility tests were	conducted v	with two to	racked vehicles (an	
Mll3Al armored personnel carrier and an M60				
1-1/4-ton cargo carrier). The vehicles wer	re operated o	easily in a	all the terrain units	
except terrain unit 4, the crater wall. The for all the vehicles until the steep slope	e crater wa.	ll OI test	d to a 17 percent	
slope. The grading required 12 minutes wit				
perienced approximately the same degree of	difficulty :	negotiating	g the crater walls	
(terrain unit 4).				
KEYWORDS: Crater ejecta; Craters;	Engineeri	ing effor	t: Explosion	
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effects; Field tests; Military vehicles; Mobility; Terrain analysis; M60Al tank; M113Al carrier; M561 carrier; Mixed Company III (Event); obstacles				
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Project DIAMOND ORE Phase IIA consisted of	the detonati	on of thre	e 10-ton charges of		
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conditions near Fort Peck, Montana, in October 1972. The purpose of the investigation					
conditions near Fort Peck, Montana, in Octo	ber 1972. 1	the purpose	of the investigation		
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12 ABSTRACT			

A study was made to determine the feasibility of using an airborne laser profilometer system to rapidly appraise selected unprepared landing sites. Evaluation of terrain roughness was made in terms of microrelief, slope, and obstructions. Laser profilometer data were collected at 12 test areas that provided variations in surface geometry, vegetation cover, and other natural and man-made features. The inherent characteristics of the laser profilometer system and the extraneous noise present in the laser profilometer output prevented a direct quantitative comparison of the laser profilometer output and reference profiles of the terrain. To overcome this difficulty, a procedure was developed for interpreting the laser profilometer output to obtain an interpreted terrain profile for comparison with reference profiles. A total of 17 specific terrain features at the 10 test areas were chosen for analysis of the capabilities of the laser profilometer system. Comparisons of the dimensions of the features as measured on the interpreted terrain profiles and reference profiles showed that the neight of terrain features could be measured with a probable error of +4 in. and a maximum error of approximately 10 in. The ability of the laser profilometer system to measure terrain clope was evaluated by comparing measurements of the change in elevation over a 308-ft interval as obtained on laser profilometer outputs and photo rammetric reference profiles. The laser profilometer system did not accurately measure terrain clope in direction (+ or -) or magnitude.

Field tests; Lasers; Microgeometry; Profilometers; KEYWORDS: Terrain; Unsurfaced runway performance and evaluation

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A study was conducted to assess the probable transfer truck (MTT) using the U. S. Army (AMC-71), which is designed to predict moleon off-road terrain. Performance of the ditions on one off-road transect each in sults show that for the three transects, to 2.4 to 21.5 percent of the traverse distant	Materiel Condility performance of the MTT was asserted to the MTT would be MTT woul	mand Ground mance of seed under , Thailand de unable	nd Mobility Model vehicles operating three loading con- , and Arizona. Re- e to negotiate from

of the year. These no-go's would be caused by traction available from the terrain being less than the vehicle required. The results also show that the speed of the MTT would be limited to 2-5 mph over most of the terrain on the three transects. Vehicle speed would be controlled chiefly by ride dynamics and acceleration and deceleration between obstacles.

Mobility; Ride dynamics; Terrain; Trucks; Vehicle KEYWORDS: performance

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15 ABSTRACT	<u> </u>		
The study reported herein was undertaken to	evaluate t	the impact	of military trans-
portation activities upon related environme	ental attrib	rutes. The	military activities
were related to their impact (: these attri	butes by me	ans of a m	atrix. This matrix
used a scale to identify the magnitude and	probability	of the im	ract. Additionally.
known mitigation and abatement practices the	at can be u	wed to min	wize adverse environ-
mental impaces were identified and briefly	described.	The princ	ipal conclusion was
that this technique provided a first approx	imation for	assessing	the effect of militar
transportation on the environment. It is r	ecommended	that fundi	ng be provided to:
(a) exploit existing dat to generate quant	itative rel	ations to	be used in developing
environmental impact statements and (b) fin	ance resear	cn in thos	e areas for which the
need to quantify exists and the lack of dat	a has been	acknowledg	ed.
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military trucks (M715, 1-1/4-ton; M5A2, 2-towed (nonpowered, nonbraked) and self-power clay test bods whose strengths ranged from cluded multiple passes over the prepared to craft tires, 10 for the trucks) at low specexemined (i.e., outer second- and third-aximoved). Curves were developed to allow so directly from the rut produced by single of trucks. These curves were developed through (tire-clay numeric N _C) that allows pneumativide range of soil strengths, wheel loads, ditions. The same numeric was shown to be and towed coefficients for the aircraft tire trucks. Examples illustrate how airfield in can easily be used with curves that descript force coefficient relations for aircraft tire performance. Appendix A shows that values be converted to California Bearing Ratio values description of aircraft operation on unsuring KEYWORDS: Aircraft tires; Clays; Military	-1/2-ton; and red condition about 110 to est beds (useds. Cnly size wheels of its strength or multiple particularly and tire size capable of cres, as well index (AI) este the N _c verifies to predict of AI estimated and use faced soils.	i M51, 5-to ons, respect to 600 cone ually 100 p ingle-wheel the M35A2 (airfield in asses of an dimensionle ormance to oze, shape, describing as multipe stimated fr resus rut do lict multipe ated from the	on) were tested under ctively, in buckshot index. Tests inpasses for the airpasses for the airpasses for the airpasses for the airpasses for the airpasses for the airpasses for the airpasses for the airpasses for the three cas prediction term be scaled over a and deflection conmultipass rut depth as rut depth for the form truck rut depth control ruck rut depth and towed ass aircraft tire cruck rut depth and toward for a nomograph
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A LIMITED STUDY OF THE PERFORMANCE OF AN I	MIERIM 3/4-TCI	WHEEL/T	RACK CONVERTIBLE
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The interim Wheel/Track Convertible Test R	ig, a uniquely	suspend	ed 8x8 wheeled vehicle

that uses wrap-around tracks for improved performance, was . sted in a variety of terrain conditions at Houghton, Michigan, and at Vicksburg, Mississippi, and in soil bins in a facility at Vicksburg. Tests were conducted to: evaluate the feasibility of the concept, determine if the track would stay on, observe interaction at the wheel-track interface to determine any possible slippage, determine ride and handling characteristics of the Wheel/Track Test Rig, which uses powered road arm suspensions, and evaluate and compare performance of the Test Rig with that of other available vehicles in tests on trails, cross-country traverses, special terrain, and laboratoryprepared soils. The Wheel/Track Test Rig performed well in a variety of terrain conditions; generally its performance equaled or exceeded the performance of both wheeled and tracked comparison vehicles. Vehicle ride and handling characteristics were considered better than those of the comparison vehicles. Test rig performance in soil in the wheel mode was impressive: a drawbar pull/weight coefficient of 0.96 was obtained on a clay soil prepared in the laboratory to a strength of 66 RCI, and a field experimental one-pass vehicle cone index of 11 was obtained. No wheel-track slip occurred during any of these tests, including tests on soft buckshot clay in which the vehicle running gear accumulated 1600 lb of mud (on a 6700-lb vehicle). Based on these tests, the Wheel/Track Convertible locomotion system is practicable, and the ride, handling, and per ormance of the Wheel/Track Test Rig suggest advanced testing, following any future design modifications. Appendix A presents the plan of tests followed in program KEYWORDS: Field tests; Laboratory tests; Military vehicles; Mobility; Soil-track interaction: Wheeled-tracked vehicles: [Houghton, Mich.; Vicksburg, Miss.

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3 ANSTRACT	Washir	gton, D. C.	
Preliminary tests of	scale-model bulldo	ozer blades w	ere conducted to
agcertain the effects of moldbos	ard coating materia	als on draft :	forces. The use of
scale models for this purpose wa	s a fully appropri	ate technique	e. However, certain
experimental difficulties, deter	mined in retrosped	t, rendered	the results
inconclusive.			
KEYWORDS: Bulldozers; Cut	ting blades: So	ale models	
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Miscellaneous Paper M-74-5 AD A017 723	L
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BEACH TRAFFICABILITY TESTING WITH OFF-ROAD	Final report
MATERIALS HANDLING EQUIPMENT, ANZIO BEACH,	6 PERFORMING ORG. REPORT NUMBER
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U. S. Army Engineer Waterways Experiment Station	AREA & WORK UNIT HUMBERS
Mobility and Environmental Systems Lab (WESFV)	
P. O. Box 631, Vicksburg, Miss. 39180	
U. S. Army Mobility Equipment Research and	12. REPORT DATE September 1974
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Field tests Tire test:	ce predictions
	eak, Virginia)
[======	
The field test program reported on herein was cond Mobility Equipment Research and Development Center from the U.S. Army Engineer Waterways Experiment the program were to (a) make a quantitative evaluateristics of three rough terrain forklift trucks wheaches, (b) validate or revise the current mobility cover larger, heavier, and more powerful vehicles,	tucted by the U.S. Army with technical assistance Station. The objectives of ation of the mobility charac- when operating over sand ty prediction formulas to

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design relations for vehicles being developed for materials handling, which will ensure the attainment of the required mobility. Maximum drawbar pull, maximum slope negotiable, and towed motion resistance tests were conducted on the beach backshore and dune areas. Sand data such as cone index, surface slope, and classifications were collected with each test. Numerous tire inflation pressure and axle load variations were tested for each vehicle. Standard-ply and radial-ply tires also were tested. Measured vehicle performance was compared to performance predicted by using existing mobility prediction formulas. The analysis of these comparisons indicates that changes are not needed in formulas to predict maximum drawbar pull, maximum slope climbing capabilities, or towed motion resistance. An adjustment factor for radial tires is indicated for all prediction formulas. The analysis also indicates that research needs to be conducted to determine effects of unequal axle loads and different inflation pressures, front and rear, on performance.

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U. S. Army Tank-Automotive Command, Warren, Michigan	<u> </u>	<u> </u>	
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HOBILITY VALIDATION TEST RESULTS FOR THE ARMORED REC	COMMAISSANCE SC	DUT AND COMPA	ARISON VERICLES
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S. AUTHORIS: (First nego, middle initial, lest nego)			
William Z. Willoughby			
Barton G. Schreiner			
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Directed by U. S. Army Materiel Systems		roject Hense	
Analysis Agency Aberdeen Proving Ground, Maryland		Tank-Automot	
	Warren, Kic	higan	
13 ABSTRACT Tests were conducted vith the Armored Reconnaissance	Scout Vehicle	(ARSV) candi	date wheeled and tracked
vehicles and four comparison military vehicles at Ab			
Kentucky. The ARSV wheeled (XMSOOW) and tracked (XM			
and Reconnaissance Carrier, the M114AlE1 Armored Com Reconnaissance/Airborne Assault Vehicle were tested			
Knox for testing with the two ARSV vehicles, the M55			
were conducted to validate the AMC-71 Ground Mobilit	y Model (AMC-71	.) at the sub	model and model levels
through submodel tests, terrain unit tests, and trav			
level of AMC-71 to develop required ride and obstacl relations in the soil submodel of AMC-71. Where nec			
making adjustments to better predict speed performan			
model, relations developed in this study indicate th			
ground roughness and over rigid obstacles are better			
turn, both vehicles are better than any of the compa			
the XMSOOW from the soil submodel, traction and moti for the effects of radial-ply tires on vehicle perfo			
present soil submodel relations for all the vehicles			
level for terrain units and traverses. Results of m	ost terrain uni	it tests show	the overall accuracy of
predicted vehicle speed for the present is at an acc			
ever, where maneuvering and tree override control ve higher than measured speed, indicating changes are n			
accuracy of AMC-71. In comparative traverse tests t			
followed in ranking by the XM800W, XM800T, and the M		-	-
KEYWORDS: Armored vehicles; Milit	ary bases:	Militar	ry vehicles;
Mobility; Performance p	-		-
Ride dynamics; [Aberdeen		-	
Reconnaissance Scout Ve	hicle: For	t Knox.	Kentucky]
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CHARACTERIZATION OF SELECTED ROAD IN WESTERN UNITED STATES	SECTIONS	Unclassified
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James H. Robinson		
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Mobility and Environmental Systems	_	AREA & WORK UNIT HUMBERS
U. S. Army Engineer Waterways Expe		Project 415-920-01-37-097
P. O. Box 631, Vicksburg, Miss. 3	19100	Order 0607-R5-74
U. S. Department of Agriculture, I	forest Service	September 1974
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Subgrades	[Neveda]	
Tires Unsurfaced roads		
20. ABSTRACT (Cantinus on reverse elds if necessary and		
Data were collected by the U. S. A		
characterize sections of gravel rejunction with a U. S. Department of		
road deterioration study. The pri		
was to describe, in quantitative t		
sections of unpaved road surfaces	•	<u> </u>
the western United States. Data a		

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20. ABSTRACT (Continue 1)

course in Hevada. Data survaries are presented in tables. Table 1 lists road data associated with the Febricle tire wext-road deterioration tests, and table 2 presents additional data for a lesser number of selected road test sections and one test course. The data include identification of surface type according to the Forest Service scheme; values of gravimetric and nuclear moisture content and density; volume, depth, and moisture content of loose surface materials; soil strength in terms of California Bearing Ratio and cone index; and material classification according to the Unified Soil Classification System. The results iniicate that the road sections selected for the tire wear-road deterioration study represent a fairly wide range of surface characteristics for which data were collected. Observations revealed that the maximum safe speed that could be attained on the roads by the test vehicles was controlled primarily by curvature-visibility, grade, and roughness, in that order. It is recommended that road deterioration and performance criteria be established, and that tire wear and/or road deterioration state-of-the-art studies be conducted, including the formulation of first-generation analytical engineering model(s) to account for pertinent tire wear, road deterioration, and vehicle-road interactions in a systematic manner. Appendix A presents results of tests conducted to measure the ride quality of two vehicles used by the Forest Service in logging operations. Appendix B sets forth the study requirements as defined by the Forest Service.

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MAPPING OF SELECTED ARSV TEST COURS	EFS AT FORT KNOY	5 TYPE OF REPORT & PERIOD COVERED
KENTUCKY, AND COMPARISON WITH OTHER	•	Final Report
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Donald D. Randolph		
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Exper	iment Station	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT HUMBERS
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Military bases Terrain ana Military vehicles Terrain ana		. Germany]
Military vehicles Terrain ana Mobility Terrain fac	•	
Temperate regions [Fort Knox,		
10. ABSTRACT (Continue on reverse elde if necessary and	• "	
Two test courses (FKDC and FKNC) at	Fort Knox, Kent	ucky, totaling approximately
37.4 miles of roads and trails that	had been used f	or conducting vehicle tests
with Armored Reconnaissance Scout V	ehicles (ARSV's)	and comparable vehicles,
were mapped by techniques developed Experiment Station. The factors ma		
graphic slope, obstacles, surface r	oughness, and vi	sibility. Standing
vegetation was not present on any o	f the trails. T	he study also included
		(Continued)

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20. ABSTRACT (Continued).

a limited comparison of the two test courses (FKDC and FKNL) with other Fort Knox terrains (FK1, FK2) and West Germany terrain (WGT). FK1, FK2, and WGT were mapped in previous studies on the basis of the single factors used to describe these test courses, i. e. soil strength, slope, surface roughness, obstacle magnitude, and visibility. It was concluded that the surface strengths of FKDC and FKNC are greater than those of FK1, FK2, and WGT. The slopes in FKDC and FKDC are similar to those in FK2 and WGT. The surface roughness and obstacle magnitude are greater in FKRC than in any of the other areas. The obstacle vertical magnitude factor classes are greater for FMC than for FMC or WGT. The visibility is somewhat similar and quite good In all the areas considered. Based on the five factors considered (soil strength, slope, surface roughness, obstacle vertical magnitude, and visibility), FADC is more similar to WGT than is FANC, and FANC 's more similar to FK2 than to FK1, FKDC, and WGT. It is recommended that the AMC-71 Mobility Model be used to compare speed performance of the ARSV vehicles and comparison vehicles over the test courses.

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Four terrain (Continued)

methane at different depths of burial and stemming conditions at the Peason Ridge Artillery Range of Fort Polk. Louisiana, at intermittent periods from 23 August to 31 October 1973. Mobility experiments were conducted to determine the degree to which the craters and their associated ejecta fields con-

stitute a physical barrier to the movement of military vehicles.

20. ABSTRACT (Continued)

units in each crater and ejecta area were delineated as significant to ground mobility and described in terms of soil strength, soil moisture content, surface configuration, ejecta depth, and areal extent. The test vehicles (i.e. the M60 tank, the M113A1 armored personnel carrier, and the M715 cargo truck) could operate with ease in all the terrains except the crater walls (Terrain Unit 4) and the crater floors (Terrain Unit 5). The crater walls were impassable for all the test vehicles because of steep slopes, and the crater floors of all the craters were impassable for the M60 and M715 because of soft soil conditions. The M113AL could operate on the crater floors of all the craters except the 12-MS. The engineering effort (time required by a D8 bulldozer) to make the craters passable for the test vehicles was 2.33 hours on the 12-MS crater, 3 hours on the 12-MPS crater, 2.17 hours on the 6-MS crater, and 3 hours (estimated) on the 6-MU crater. Degradation of vehicle performance in terms of drawbar-pull coefficient and speed increased for all three test vehicles in each terrain unit from the original surface to GZ. On the basis of degraded area per charge yield, the 6-AU crater was the most effective for all three test vehicles. The 12-MPS crater was the least effective for the M113A1, and the 12-MS crater was the least effective for the M60 and M715. Vehicle performance in the terrain units was predicted using the U.S. Army Materiel Command Ground Mobility Model (AMC-71) for predicting off-road vehicle performance, and measurel and predicted values for four performance parameters (arawbar pull, go-no go, motion resistance, and speed) were compared. The accuracy of the predict.ons was acceptable for all performance parameters except vehicle speed in the cratered areas.

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TERRAIN DESCRIPTION, VEHICLE ME COVER AND CONCEALMENT CHARACTER		Final report
BUSHMASTER MIDDLE EAST AND EURO A QUALITATIVE ASSESSMENT		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(a)		S. CONTRACT OR GRANT HUMBER(4)
Harold W. West Barton G. Schreiner		
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U. S. Army Engineer Waterways I Mobility and Environmental Syst P. O. Box 631, Vicksburg, Miss.	tems Laboratory	AREA O NOME ON THE REAL PROPERTY.
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Computerized simulation Mobility

Temperate regions

Military operations

Concealment

Desert regions

Terrain analysis Military vehicles War games

[Bushmaster (Weapons system)] Performance predictions [Middle East]

[West Germany]

A study was performed to provide terrain description, vehicle mobility, and cover and concealment characteristics on two 6- by 7-km areas; one in the Middle East and the other in West Germany. These data were then to be used as input to two war-game computer simulation models (the Bonder Individual Unit Action and Carmonette Models) in the overall program to perform a cost and operational analysis on the use of Bushmaster versus alternative weapon systems. (Continued)

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COMPARISON OF THE RIDE QUALITIES OF		Final report
M60A1 AND HYBRID (TUBE-OVER-BAR) M	BUATES TANKS	S. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(a)		6. CONTRACT OR GRANT NUMBER(s)
Newell R. Murphy, Jr. James H. Robinson		
9 PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT HUMBERS
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Mobility and Environmental Systems P. O. Box 651 Vicksburg Miss. 3		
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Military bases Tank Mobility Term	dynamics s (Combat vehic ain Knox, Ky.]	[M60Al tank] cles) [M60AlE3 tank]
20 ABSTRACT (Continue on toverse side if necessary and	Identify by block number)	
Ride and shock tests were conducted selected rough terrain courses in to compare their ride quality and (it any) offered by the hybrid tube 1600AlE3 tank. The data were to profor input to the DYNTACS computer	the Carpenter To determine the ro be-over-bar susp covide better-qu	est Area at Fort Knox, Ky., elative improvements in ride ension configuration on the ality terrain-limiting speeds

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20. ABSTRACT (Continued)

Dynamics data in the form of linear and angular accelerations and absorbed power were obtained for both tanks at the driver's and the tank commander's positions with the main gun in the forward-free and the aft-locked positions. The tests were conducted in inclement weather on wet, muddy courses, which limited the maximum attainable speeds to about 15 mph. As a result, ride-limiting speeds were rarely attained. The data were extrapolated as necessary to develop the terrain-limiting speed relations required for computer combat effectiveness studies. However, because the reliability of the results way somewhat questionable, the basis for the evaluations focused more on direct comparisons of the various ride levels that were reached. Daca, which are illustrated in the form of tables and graphs, indicate that there is no significant difference in the ride qualities of the two tanks, although the tanks' occupants insisted that the M60AlE3 gave a better ride. Other conclusions are that ride quality is not affected by rotating the main gun from the aft-locked position to the forwardfree position. Also, there is no distinct difference between the vertical absorbed power at the driver's seat and that at the tank commander's observation seat; however, the sum of the vertical, fore-to-aft, and side-to-side absorbed power at the commander's observation seat may be as much as four, five, or more times the intensity at the driver's seat. Relations representing the data obtained from an earlier test program involving ride comparisons of a standard M60Al and an M60A3 (complete tube-over-bar suspensions) tank are shown to illustrate the significant ride improvements that were attained with the tank configured with the complete tube-over-bar suspension. These data led to the belief that the complete tube-over-bar configuration offers a significant improvement in ride quality, whereas the hybrid tube-over-bar configuration provides no noticeable advantage. It is recommended that a comprehensive ride dynamics test program be conducted with an M60Al tank, an M60AlE3 hybrid tubeover-bar tank, and an M60A3 tank to determine the relative merits of these three configurations and, furthermore, that this program receive the proper support from the appropriate agencies to ensure that the required test conditions are met.

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generation version of a comprehensive analytical model for evaluating the mobility of ground vehicle systems and the modifications that distinguish it from the first generation (AMC-71) version. The second paper, Terrain Modeling to Support Mobility Evaluation, describes the procedure and recent developments in terrain modeling to evaluate ground mobility. The third paper, Pide Dynamics Modele for AMM-75 Ground Mobility Model, describes the computer module for simulating the ride and shock response of any rigid-framed vehicle and determining the relations necessary for input to the AMM-75 Ground Mobility Model to assess the effects of ride- and shock-limiting speeds on mobility. The fourth paper, Validation of the AMC-71 Mobility Model, describes the results of a comprehensive experimental program to validate and evaluate predictions of vehicle performence derived from the first generation (AMC-71) Mobility Model.

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analysis of data includes variations in soil strength that occur in dry-tomoist sends, the variations that occur according to beach location, variation between beach and desert sands, and variation between sand types. Also included is a discussion of the areal distribution of beach and desert sands on a worldwide basis, the factors affecting sand stabilization, and some of the more pertinent stabilization methods. By using verified vehicle performance evaluation procedures and methodology that considers the effects of tire inflation pressure, surface slopes, frequency of occurrences, and sand strength and type, the periormance of a wheeled dozer, modified for handling containers, can be estimated on an areal basis. Practical stabilization of beach sands can be achieved by densification of the sand, by the introduction of cementing agents to increase sand bearing capacity, or by construction of temporary roadways. Current design and evaluation methods employed in stabilizing natural soils for road and airfield construction are not entirely applicable for designing expedient stabilized beach sand sections for transportation throughways. Appendix A presents a list of selected references concerning soil stabilization.

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density values for a wide variety of materials. Recent advances in the design of nuclear equipment and a better understanding of the nuclear principles involved have led to increasingly widestread use of nuclear gages in earth construction control work. This report describes surface-type nuclear equipment, procedures, and various test methods used for making shallow-depth moisture and density determinations in place on soil and soil-aggregate mixtures. In general, a 6-in. direct transmission density test using a properly operating nuclear gage and an up-to-care factory call-bration curve will yield test results slagatly better than those of conventional density tests. The factory noisture calibration curve, however, must be checked and adjusted (if necessary) for each material tested. The nuclear test is simpled to perform than conventional tests and requires only about 15 min to obtain both a density and moisture test result. KEYWORDS: Nuclear equipment; Nuclear methods; Soil aggregates; Soil density measuring devices;								
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The terms in the microthesauros cover three major areas of interest: vehicle mobility, environment, and pavements, as related primarily to military research Non-technical terms common to all subject areas in research and development are included to provide a complete vocabulary of concepts. The microthesaurus will become part of a larger version encompassing several subject areas of particular interest at the U.S. Army Engineer Waterways Experiment Stavion. The format, rules, and conventions used in this document generally follow					
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This report presents a bibliography of papers related to activities of the Mobility and Environmental Systems Laboratory of the U. S. Army Engineer Waterways Experiment Station published in technical journals, special publications, transactions, or proceedings, or presented at meetings, symposiums, or conferences from June 1955 through November 1974. A subject index is included.

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	•	U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi				
Methods of predicting soil moisture of the Vicksburg area, Park, Rifle and Moundation methods consisted of a daily record of 1951, for each site and concurrent data or ity and wind movement. Development and decally. Soil studies included profile desidensity, moisture content at wilting point rension relations. The soil moisture recombisture content at 8 to 10 depths in the the Colman soil moisture meter and fibergly dicted at the 6- to 15-in. depth. The amodepth following rainfall was found to be and available storage. Depletion curves is similar throughout the entire period. Available storage.	Basic data of soil moist a rainfall, a ensity of veg criptions and and field cord consisted upper 42 in. as units. Sount of soil dependent on in the soil moist.	from which ure from l ir and so etation we determine apacity, of a dail This recoil moisture the relationsture re-	ch to dewelop predic- 1 April to 1 October 11 temperature, humid- ere checked periodi- ation of texture, bulk and soil moisture- ly inventory of soil cord was obtained with ure contents were pre- accretion at this ion between storm size ecord were very			

KEYWORDS: Soil moisture prediction; Temperate regions; Trafficability; Vicksburg, Miss.

developed for each 3-in. layer from 0 to 15 in. Depletion rates, in general, were exponential in form with rates of loss tending to decrease with depth. No relation was found between depletion rates and air and soil temperatures, humidity, wind and vegetation composition. The accretion and depletion methods were combined to predict soil moisture content for the period of roard. Consistent agreements were obtained

between actual and predicted values of soil moisture content.

Prediction methods for the period October 1951 to April 1952, the "Winter" season, were developed for the same three sites (Park, Rifle, and Mound, Vicksburg, Miss.) as reported in Progress Report I for the summer season. Basic data from which to develop prediction methods consisted of a daily record of soil moisture, water table records, and concurrent data on rainfall, air and soil temperatures, humidity and wind movement. Condition of vegetation was checked periodically; soils were classified. As in the summer season, soil moisture accretion during winter was found to be dependent on storm size and available storage. For the major part of the period depletion rates were markedly below summer rates. Following rainfalls that saturated the soil, one to two days were required to drain to field capacity; further depletion proceeded at a very slow fairly constant rate. Rates decreased with depth. High water tables affected accretion and helped to maintain high moisture contents. The accretion and depletion methods were combined to predict soil moisture content for the period of record. C 'listent agreements were obtained between actual and predicted values of soil moisture content. Summer soil moisture depletion data in Progress Report I were reevaluated and a search of literature made to determine soil moisture depletion rates from other areas. Results of six special studies dealing with instrumentation, calibration of soil moisture units and interrelationships of soil moisture to volume weight and root concentration are reported.

KEYWORDS: Soil moisture prediction; Temperate regions; Trafficability; [Vick.burg, Miss.]

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Prediction methods for the period October 1951 to April 1952, the "Winter" season, were developed for the same three sites (Park, Rifle, and Mound, Vicksburg, Miss.) as reported in Progress Report I for the summer season. Basic data from which to develop prediction methods consisted of a daily record of soil moisture, water table records, and concurrent data on rainfall, air and soil temperatures, humidity and wind movement. Condition of vegetation was checked periodically; soils were classified. As in the summer season, soil moisture accretion during winter was found to be dependent on storm size and available storage. For the major part of the period depletion rates were markedly below summer rates. Following rainfalls that saturated the soil, one to two days were required to drain to field capacity; further depletion proceeded at a very slow fairly constant rate. Rates decreased with depth. High water tables affected accretion and helped to maintain high moisture contents. The accretion and depletion methods were combined to predict soil moisture content for the period of record. Criatent agreements were obtained between actual and predicted values of soil moisture content. Summer soil moisture depletion data in Progress Report I were reevaluated and a search of literature made to determine soil moisture depletion rates from other areas. Results of six special studies dealing with instrumentation, calibration of soil moisture units and interrelationships of soil moisture to volume weight and root concentration are reported.

KEYWORDS: Soil moisture prediction; Temperate regions; Trafficability; [Vick.burg, Miss.]

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KEYWORDS: Environmental analysis; Environmental factors; Subarctic regions;

Trafficability; [Fort Churchill, Canada]

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U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi

2. SPONSORING WEITARY ACTIVITY

D. ABSTRACT

THE PROPERTY OF THE PROPERTY O

This report reviews the history and current status of vehicle mobility research for use in providing background information in the planning and programming of Corps of Engineers activities in the field. Two previous reviews in mobility research, the Review and Evaluation of Research Related to Trafficability of Beaches, by Horonjeff, Seed, Van 11, Wiegel and Trask, published July 1953, and A Practical Outline of the Mechanics of Automotive Land Locomotion, by Bekker, published June 1955 cover the field rather completely. The review by Horonjeff and his associates is concerned largely with the situation as they found it, and is a thoroughly objective report with little interpretive criticism. The outline by Bekker is a more personal appraisal of the situation, presenting problems and approaches which reflect both the author's long and thoughtful association with off-road automotive work, and his personal philosophy as to its proper approach. Both surveys agree upon the necessity for research on the fundamentals of vehicle—soil interaction, and upon the use of relevant knowledge and techniques from related applied mechanics fields.

KEYWO'CDS: Mobility; State-of-the-art studies

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This report summarizes past accomplis	hments and c	urrent act	ivity in vehicle					
mobility research, with emphasis upon soft	ground cros	sing. The	present report					
is prepared specifically for use by the Wa	terways Expe	riment Sta	tion (WES) in					
establishing its program of research on ve evaluations have been made by competent pe	nicle mobili	ty. Sever	al summaries and					
the situation from the British viewpoint is	rsons in the n 1948 UES	past lew surveyed t	years. noad reviewed he field for the					
trafficability aspects in 1949, and Bekker	covered the	entire fi	eld in a series of					
lecture nates in 1952, which he summarized	in 1954 and	again ir.	1955. Wheeled					
vehicle tests were reviewed by Kelly in 19	52, tire tes	ts by Shie	lds in 1954, and					
many aspects of mobility, in relation to b	each traffic	ability, w	ere covered in 1951					
by Seed and in 1953 by Eoronjeff et al. F								
recent British activity. The status of re and evaluated by the authors, and current	search on se	verar 18Cf	d At the conclusion					
a suggested program of further research is	outlined.	A reasonab	ly complete bibli-					
ography of pertinent material is included.								
KEYWORDS: Mobility; State-of-the-art studi	es							
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This study is part of a comprehensive program of research devoted to further knowledge concerning the estimation of quantitative soil trafficability information by remote means, particularly through the correlation and analysis of aerial photographic patterns. The report discusses previous investigations in this field and factors that influence soil trafficability. Techniques are presented for photo interpretation of soils and landform elements; the effects of season and scale in inferring trafficability information are described. A two-year study was undertaken at three test areas in Indiana to test the validity of the technique. Photo tones and texture were correlated with soil moisture and ground conditions.							
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13 ABSTRACT This report discusses environm	mental elements	found	at Fort Greely, Alaska
that are both stable and variable with melements treated are topography, landforwater. Elements exhibiting marked seasond temperature, vegetation, snow, lakes the testing and training activities at found in the test area are evaluated for for elements common to the subarctic, for distinctive, for terrain factors representative of cross-country movement. Il as	respect to seaso rms, geology, so onal variations s and streams. Fort Greely. The r the important or major factors ented in the tes	oral charlotte, poils,	ange. The stable ermafrost, ard nund nd action, sold moistur iscussion is made of ronmental factors and seasonal elements, make the test area and for the feasi-

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KEYWORDS: Environmental analysi:; Military bases; Subarctic regions; Trafficability; [Fort Greely, Alaska]

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Representative surface geometry profiles from those presented in the Waterways Experiment Station Technical Report No. 5-625, "Environmental Factors Affecting Ground Mobility in Thailand," Appendix E, are fitted by Four:er-series curves. Fit accuracy appears satisfactory and justifies confidence that all such microrelief profiles can be so described mathematically. The feasibility of using a Fourier-described terrain in finding the response of a vehicle traversing the terrain is confirmed by comparing the results of a digital computer program when using an arc and straight line bump description and when using a Fourier-series bump description. A simplified two-degree-of-freedom mathematical model of the M37 truck is used in this comparison. A seven-degree-of-freedom mathematical model of the M37 is made and a digital computer program developed to solve its differential equations of motion. A check is made of this program by comparing responses of the seven- and two-degree-of-freedom models to the same Fourier-defined terrain using their respective programs.								
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The object of the investigation was, first, to find out if a radar can be used in a laboratory to provide data on terrain studies, and, if so, to find out whether such a radar can be made from conventional simple components and if necessary, used in an airplane. The investigation was carried out in three steps, which were

(1) Radar Study, (2) Facility Design, and (3) Specimen Design. No existing radar is suitable for use both in the laboratory and in airborne operation. Nowever, existing radars and radar components in the K-, K-, C-, and P-bands can be modified so as to be used in both laboratory and air. It was recommended that the radar used in WESTAR be the AN/TPS-21 or its equivalent, with required modific tions. The operating variables of this radar have been used to set the specifications of the laboratory structure and the specimen containers. The specifications and results in this report constitute the recommendations for the establishment of the laboratory facility.

KEYWORDS: Laboratory tests; Radar; Radar equipment; Kemote sensing; Soil tests (Laboratory); Systems analysis; Terrain analysis

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Texas Instruments is assisting in the study of terrain analysis by radar in a laboratory environment. The design of the radar laboratory was established in Phase I, System Analysis, of the project. This Phase II report includes description of Phase I design and fabrication and installation of designated or moments of the WESTAR facility. These components are from three sources: (a) government furnished equipment, e.g. various subunits of the operational radar set AN/TPS-33; (b) Texas Instruments fabrication and model shops, e.g. the control couscle; and (c) commercial vendors, e.g. radar antennas. Other than system control and read-out elements, the system operates in an open-end archway 44 ft long and 100 ft wide at the base with an arch radius of 50 ft. A carriage, mounting the receiver-transmitters, a control junction box, and radar antennas, is track mounted to the arch and is capable of traversing a segment of the arch from the zenith to nearly ground level. Terrain specimens are prepared in wooden containers, track mounted on the floor of the WESTAR facility. Preliminary laboratory testing, calibration, and data collection indicate system losses are negligible, the radar system is functioning as designed and is expected to collect determinative terrain information at all radar frequencies provided.

KEYWORDS: Laboratory tests; Radar; Radar equipment; Remote sensing; Soil tests (Latoratory,; Terrain analysis

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A laboratory gamma ray spectrometer ment Station, Vicksburg, Mississippi, and ments has been initiated to investigate t soil type and trafficability parameters b ray spectra. Freliminary measurements on and Yuma sand have shown that the charact measured accurately and may be useful in the gamma ray spectrum, which is caused b stitial moisture, shows sufficient measur a basis for a future remote moisture meas laboratory measurement of many more varie ranges of values within types with varyin should be supplemented by a carefully des variables not easily reproducible in the within soil types, effects of meterologic modifications.	a program of he possibility the charact the Long Lake e istic nature identifying ty scattering able variation uring techniquies of the mag moisture coigned field plaboratory.	controlleries in remeristics of clay, Open al radioal the soil ty and absorp to offer yee. Future sjor soil ontent. The trogram to These incl	d soil sample measure- otely determining f the natural gamma enwood Street silt, ement contents can be pe. Distortion of tion in the inter- definite promise as e work should include types to determine te laboratory work investigate in-place ude veriations
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13 ABSTRACT				
A study was made to determine the fear for observing, analyzing, and forecas relied chiefly on an extensive litera survey, and interviews with personnel with an interest in the subject. It indicators of the state of the ground ature and soil strength. It was furt type is being collected at numerous s evidence of standardization of instru	ting the state ture review, a of U. S. civil was found that were soil mois her found that ites around the	of the good of the good of the most ture corwhile in world,	ground. The study le questionnelre military agencies widely useful atent, soil temper- aformation of this there is little	

vations. Suitable methods are presently swallable for developing an integrated state-of-the-ground system, but improvements in the methods are desirable. Three systems are suggested, one for international use, one for civilian use in this country, and a third for U. S. military use on a worldwide basis.

Environmental analysis; Soil moisture; Soil strength; Soil temperature; State-of-the-art studies; State of the ground; Terrus analysis

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Final report in 4 volumes					
S AUTHOR(5) (Last name first name initial)					
Van Deusen, B. D., and Hoppe, C. H.					
6 REPORT DATE Vols 1 and 2, March 1965	70 YOTAL NO OF PAGES 176 NO OF REFS VOI 1, 189 (1) 2, 34: VOI 4, 29.				
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sponse to Vehicle Vibration (vol 2): The	ur critical elements as follows: Human Re-				
tion is that of human response to motion	n caused by terrain irregularities. A criti-				
ify the possibility of measuring physical	 A feasibility study was conducted to ver- al magnitudes which are correlates of the sub- terminate of the sub- terminat				
bration acceleration variance, as a fun-	chicle environment. It is concluded that vi- tion of frequency and raised to the proper				
power, is a measure of ride sensation. ical review of the literature, two metho	Theoretical Dynamics (vol 3): After a crit- ods were selected as applicable to mathemati-				
cal modeling of vehicles. A frequency of	domain approach is developed for detailed t dictated by human response considerations.				
For nonlinear systems, the calculation	is performed in the time domain with output				
is given. Field Measurerents (vol 4):	n example of both methods for an M37 model It is concluded that no automatic profile				
measuring device is available which give	es an accurate measure of the profile informa				
tion necessary for vehicle dynamics. A feasibility study was made to measure notice of an XM-10 wheel. This method of profile measurement does not appear satisfactory					
nt present, but further development is suggested. Surveying techniques seen to be the most accurate terrain measurement method available. To measure vehicle respons-					
accelerometers, properly positioned and interpreted in terms of power spectral density, should be used. Summary (vol 1): A simple method for comparing vehicle vibrometry.					
tion over various terrain has been developed; the vehicle is specified by 3 numbers					
the terrain by 2. Simple arithmetic allows an estimate of vertical vibration in each of 3 frequency bands for any given vehicle over any given terrain.					
KEYWORDS: Mathematical models; Mobility	; Ride dynamics; Vibration effects (Vehicles)				
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13 ABSTRACT	<u> </u>			
The test procedures and techniques devide a means of obtaining photoelastic controlled degrees of slip. Sufficient mal and shear stress distribution on prounth inch of the contact surface bet certain approximations are made. Furt the stress at a point. Concerning the on the gelatin model, it was found that stress for the moving wheel load at 0 lent static wheel load. This increase distribution of normal stress at the wasmaximum shear stress under the action 0 slip than at +25% and +50% slip.	stress patterns for information was declared in the gelating ween the moving wheeler study is indicated action of the station	moving wheel loads at eveloped to compute nor- foundation within one- load and gelatin, if ded to accurately define cand moving wheel loads ase in maximum shear over that of an equiva- ress was due to a re- le gelatin. Also, the		
KEYWORDS: Gelatin models; Mobility; Pl under wneels; Wheels	notoelasticity; Stres	s distribution; Stresses		

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This was the first major attempt to correlate terrain surface obstacles (lateral, longitudinal, and vertical) with vehicle performance. Purpose of the study was to develop and/or evaluate (1) measurement systems necessary to permit quantitative description of vehicle performance and the terrain on which vehicles are operated (2) test methodology including proper experimental design (3) methods of analysis leading to quantitative vehicle-performance relations (4) approximate limits for both "immobilization" and "no-effect" values of important parameters and (5) a study plan which will include an analytical framework within which more extensive future studies should be analyzed. Analysis of test data revealed the important terrain-vehicle relations for cross-country mobility and the proper methods of measuring and analyzing important terrain-vehicle parameters.					
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A semiempiric, dimensionless load coef				
field and laboratory data on the perfo	rnance of pneur	natic ti	res in dry sands.	
The coefficient appears to collapse th	ese divers: dat	ta to a	useful degree.	
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final form of the numeric is presented	l .			
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• KEYWORDS: Dimensional analysis; modility numbers; rneumaric tires; Sands; Soil- wheel interaction				
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Clay, through measured vehicle tests and					
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tractor in (a) a dry sand and (b) a slip		dition	on a clay by means of		
t measured renicle test and predicted pe		_			
These vehicle tests were performed	with a single pa	iss thr	ough the undisturbed		
test course. The vehicles chosen repre-					
nicle characteristics using a minimum number of vehicle types. The choice of vehi-					
cles included a 1/4-ton M38A-1, 3/4-ton M37, 2-1/2-ton M35A1 (modified to single					
11.00-20 tires), M39C Amphibian, M115 Personnel Carrier, and a POLECAT 914 articu					
lated steering vehicle.					
The test results are discussed in terms of the accuracy of predicted vehicle					
performance. Particular emphasis is given to causes of differences between predict-					
ed and measured performance values.					
KEYWORDS: Field tests; Mulitary vehicles; Mobility; One-pass performance; Soil-					
vehicle interaction; Traffica		•	1		

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This report presents results of an inveself-propelled vehicles in natural, weapurposes: (1) to develop (a) a reliable with which predictions may be made of the pass on a straight, level course, and (with the soil strength index to establi (2) to provide means to predict (a) one soils having strengths in excess of the level terrain, (b) the increment of soil hicle to maneuver freely, and (c) the pring in a terrain situation where the soload index. First-order answers are proposed to the	k, fine-grained e strength index he performance o b) a nominal veh sh whether or no -pass drawbar pu minimum required strength index robable maximum il strength index five basic quest	soils for f f a ve icle 1 t a ve 11 and d for neces speed x exce	for the following ine-grained soils hicle on its first oad index to be used hicle will go; and slope performance in one vehicle pass on sary to permit a veof a vehicle operateds the net vehicle
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KEYWORDS: Fine grained soils; Mobility; One-pass performance; Self propelled vehicles; Trafficability; Vehicle cone index

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13 ABSTRACT

U. S. Army Engineer Waterways

Experiment Station, Vicksburg, Miss.

This report highlights the accomplishments of an instrumentation team from the Colorado State University which provided technical assistance to the Advanced Research Projects Agency in Thailand. The major portion of the work load was connected with vehicle testing. During the contract period the Colorado State University Thailand Trafficability Instrumentation Team instrumented and assisted with trafficability tests of the following vehicles: Dodge Power Wagon, Vickers Hover Truck, M37 3/4-ton truck, Spryte, XM-561, Rolligon, M116, and XM571. The details of tasks involving the design and operation of instrumentation systems for research and development related to vehicular trafficability are reported.

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KEYWORDS: Military vehicles; Mob .ity: Trafficability; Tropical regions; Vehicle test instruments; [Thailand]

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The state-of-the-art of off- oad vehicle de	esign, espec	ially of m	ilitary vehicles, is	
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guish off-road vehicles from related equip	ment. The p	rocedures	by which off-road	
military vehicles advance from concept and reviewed, and some relations between appar	or requirem	ent to lie	es and the adminis-	
trative procedures are pointed out. It is	concluded t	hat to pro	vide the more mobile	
vehicles needed by the Army in the field in	n Southeast	Asia a com	plete second family	
of off-road military vehicles is required-	-an integrat	ed, compat	ible system of	
vehicles optimized for operations in South	east Asia re	ther than	in Europe, as is cur	
present standard fleet. Organizational ch	anges which	would spee	d such an approach	
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A rese rch program was conducted "to determ	nine feasibili	ty of mea	suring moisture con-		
tent of soils by measuring the amount of u	ltraviolet lig	ght trease	ission through		
moisture contained in a soil analog encase	l in a quartz-	granule w	afer emplaced in the		
soil." Results obtained from many combina	tions of soil	analogs s	und system geometry		
indicate that the concept is operationally	impractical.	Selected	l in trumentation de-		
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of the initial concept. One variation inve	groce investigation	sacron on	Cookensker Under		
Inhomitony conditions refractorates to	oived critical	. angre re	raccometry. Under		
laboratory conditions, refractometer-type	systems repeat	edly yiel	ded signal outputs		
directly correlative with the percent (moi	sture) saturat	tion of al	.i soil samples pro-		
vided. This performance was achieved inde	pendent of soi	.1 tempera	ture and variations		
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tometers is necessary for establishing the	performance of	of, and ar	ecifications for.		
any operational units. A promising config	ration for fi	eld test	units was prepared.		
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of 1963 and terminated in the summer of 196	5. The obje	ctives of	the study were to			
(a) determine whether particular water tabl	e regimes ar	e associat	ed with specific soil			
types, (b) achieve the capability for appra						
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prediction methods for water table depths,						
Data obtained daily at each site included m						
precipitation, groundwater depths, and elec						
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soil moistire contents, soil strengths, and						
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limits. grain-size distributions, specific	gravities, o	organic mat	ter contents. moisture			
contents at specified tensions, dry densities, site descriptions, and soil profile						
description. The data above have been condensed in tabular and graphic form for						
presentation herein. Also included are bri						
physiography, climate, soils, and land use						
ture unit readings and corresponding graving						
included in Appendix A. An analysis of the	data 15 to	oe present	ed tu soffwe II or			
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Tables, maps, illustrations. Six appendic	es.			

KEYWORDS: Beach terrain; Beach trafficability; Land-water interface; Surface geometry; Trafficability; Vegetation; [Florida]

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western side of peninsular Florida. The sites were chosen to be representative of low-energy, marshy coasts. The report presents verbal descriptions of the sites in terms of topography, vegetation, soils, and trafficability. Detailed strip maps portraying these factors, with a "characteristic central profile," are given in an appendix. However, the sites are not classified by the system presented in the previous report, nor is any mention made of this system. Photographs, as well as detailed data on soils trafficability and vegetation analyses, are given in appendices. The following conclusions are presented: (a) Environment of the study area is a resultant of the geology and climate, and of the vegetation produced by geology and climate. (b) The sites are made up of the following elements: tidal flats, topographic highs (barlike features) separating tidal flats from marsnes; marsnes with tidal channels and hammocks (topographic highs with dense vegetative cover). (c) Soils are predominantly poorly graded sands with admixtures of peat in the marshes, which latter become critical trafficability obstacles. Limestone outcrops occur in the tidal flats and hammocks. (d) The sea-land boundary zone can be relatively easily penetrated by personnel familiar with the terrain. (e) The tides on the investigated area are mixed. Tidal ranges are about 1 meter, but higher and lower ranges occur. Velocities and directions of current in the tidal channels are erratic. Tables, maps, illustrations and appendices. KEYWORDS: Beach terrain; Beach trafficability; Land-water interface; Marshes; Surface geometry; Trafficability; Vegetation; [Florida]						

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